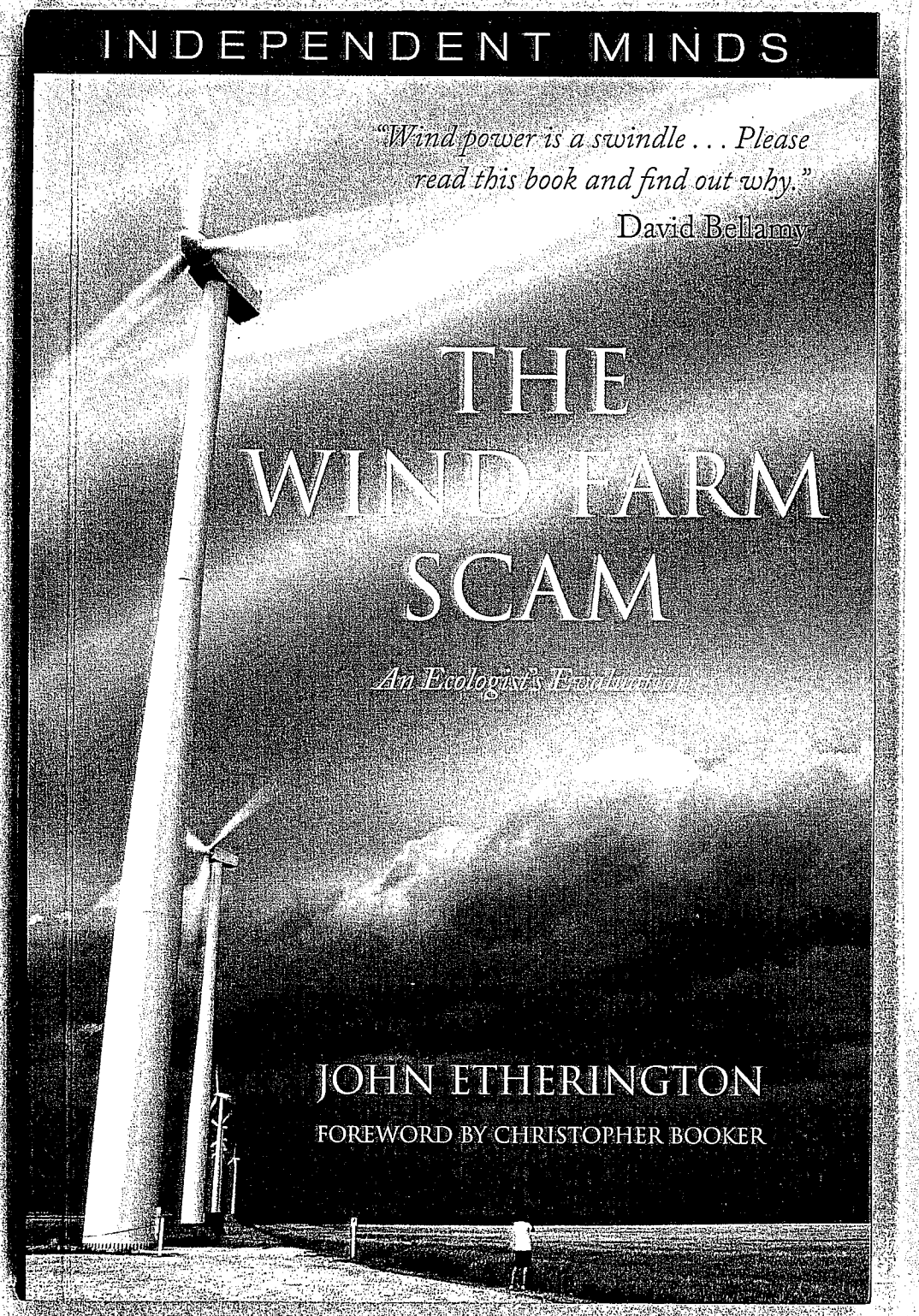
COSNER
V.
UMATILLA COUNTY

LUBA NO. 2011-070, 2011-071, 2011-072

Local File Number
Text Amendment, #T-10-042

CONSOLIDATED RECORD

VOLUME 6 of 8, Page 3328 - 3794


INDEPENDENT MINDS
"Wind power is a swindle . . . Please read this book and find out why."
David Bellamy
THE WIND FARM SCAM
An Ecologist's Expose
JOHN ETHERINGTON
FOREWORD BY CHRISTOPHER BOOKER

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The Wind Farm Scam

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Foreword

I owe John Etherington, the author of this book, a considerable debt. Over recent years he has given me invaluable technical guidance on one of the most extraordinary stories I have covered in all my decades as a journalist.

For me it all began back in 2002, just after Tony Blair had announced plans for a huge increase in the number of wind turbines to generate electricity in Britain, to meet targets set by the European Union in its bid to "fight climate change".

My eye was then caught by a report that Denmark, the country which had more wind turbines per head than any other in Europe, was reining back hard on building any more. It seemed they were not generating very much electricity, that what little they did produce had made Danish electricity the most expensive in Europe and that any savings in CO_2 emissions were virtually non-existent.

This seemed such a contradiction to the, then, still widespread belief that wind power provided a "free", "clean", "green" way to produce electricity – particularly since Mr Blair was now making it the centrepiece of his energy policy – that I decided to look into the facts behind it.

A friend put me on to Country Guardian, an internet site run from a cottage in Wales by Angela Kelly. She turned out to be a remarkable widow in her 70s, who has done more than anyone else in Britain to keep an ever wider circle of readers briefed on the facts about wind power. She put me onto one of her technical advisers, Dr Etherington, an academic scientist with a background in both energy and environmental issues. And it was he more than anyone else who opened my eyes to the extraordinary series of illusions on which this new political infatuation with wind energy was based.

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Blue Mountain Alliance

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APR 14 2011
UMATILLA COUNTY
PLANNING DEPARTMENT

April 13, 2011
Umatilla County Commissioners

Attn: Commissioners

Blue Mountain Alliance would like to express support of the Planning Commission's proposal on improved wind turbine siting guidelines. BMA would also like to present evidence that shows that a 2 mile setback is not excessive and refute some of the testimony that was presented at the public hearing on March 17th.

- 2 Mile setback

Please review the two maps of the proposed Helix Wind Power Project. The two maps illustrate the possible expansion of the project with 1.5MW or 3MW turbines. Two mile radius set-back circles were attached to homes which are outside the 36 decibel boundary to see if any of them would have to be added to the list which would require signed waivers in order for the project to proceed if the 2 mile setback proposal were in effect.

For the 3MW project map (HWPFigure2NoisePLus2milesetback.pdf), the following residences which are on the "up wind" side or "side wind" side of the project would be close enough to proposed turbine locations to require a waiver (or changing the location of a turbine):
(Starting at upper left and proceeding down and to the right, then north)

R70 (one turbine - F1)
R95 (one turbine – S1)
R93 & R94 (one turbine – S4)
R89 & R88 (two turbines – Y1 & Y2)
R90 (three turbines – Y1, Y2 & X3)
R94 (three turbines – Y1, Y2 & X3)
R18 (one turbine – W3)
R1 (one turbine – C6)

- Number of homes requiring waivers under "noise only" protections – 29
- Number of homes requiring waivers under 2 mile set-back protections – 39 (10 additional homes gain "protection"- all are "upwind" or in "side-wind" locations)
- Number of turbines "forced" into waiver requirement by the 2 mile setback – ***ZERO*** (all of the affected turbines are already too close to other homes under noise rules)
- Number of turbines within the 2 mile radius of the added homes – 8 (out of 67).

A notable feature of the 2 mile setback proposal is the ease of enforcement. A simple, reasonable, distance rule, applicable PRIOR to construction is far better than the situation which currently exists.

- Wind project developer completes a noise modeling study and predicts where the 36db noise line will be. Home owners outside the 36db line do not receive notification of plans.
- If the project is approved, and if the noise predictions were not correct . . . the burdened neighbor must initiate action and expend funds to investigate the problem.
- Even if a noise infraction is proven, there is significant incentive for the project developer to "buy his way out of the situation" rather than removing the offending turbine(s). In this case, a "mistake" by the developer still results in the neighbor being "forced" (through substantial economic incentive) to sell out to the developer or to "just live with it".

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- Rebuttal of previous testimony

Please also review the map titled "HWPFig2NoisePlusNewtson.pdf" which shows 2 mile setback circles drawn around the homes of Jeff Newtson, who told the County Commissioners that he lived right under the towers and they weren't a problem for him. In his written statement to the Commissioners, Mr. Newtson claimed that, "I lived within a mile and a half from the Stateline Project for seven years." However, the actual distance from his home to the nearest turbine measures at TWO AND A QUARTER miles on both the Stateline project map and on GoogleEarth. (see screen capture "NewtsonGoogleEarth1.pdf") He has moved from R-96 where he was more than 2 miles from some of the smallest turbines installed in the area and now lives in R-78, where he will be approx. 4 miles from the nearest existing (small) turbine – and where he will be about 3 and a quarter miles from the closest turbine if the Iberdrola amendment is approved. It is hard to understand how a 2-1/4 mile distance can be "right under the turbines" AND a 2 mile distance can be an excessively large setback, as he claimed, at the same time!

We have also attached copies of Mr. Levy's aerial view of the countryside immediately north of the Pendleton Aiport – with additional information. (attachments "Ex4Levy1_5MW.pdf" and "Ex4Levy3MW.pdf") It seems apparent that Mr. Levy purposefully selected an area in which the housing **distribution** would make wind project development highly unlikely even with small turbines – and probably impossible with larger turbines – with existing state noise standards. It is interesting to note that Mr. Levy's map covers 39 homes, while that same area overlaid on the Helix project noise map would cover 48 homes. (see attachment "Levy OVER HWPFig2Noise.pdf") Mr. Levy has simply identified an area which probably isn't a good candidate for wind energy development under ANY siting standards which are effective in protecting the rights of "off-project" neighbors.

- Comment on decommissioning bond situation

During the hearing on March 17th, the Commissioners were concerned about the decommissioning bond being payable to the County. The discussion seemed to center on whether the County should be "in the middle of that". Perhaps the proposed codes could be re-written to require that a decommissioning bond requirement be satisfied, but the bond can be payable to the landowner or to the county. County to be provided with proof acceptable to the County that the decommissioning bond requirement has been satisfied. All other text describing the establishment of the value of the bond, periodic value review requirements, etc. should be retained and the land owner and the project developer/owner must be bound by those requirements.

- Suggested addition to code amendments

Members of BMA have come to the realization that no text in the proposed codes provides for simple physical safety setbacks of turbines from a neighboring property line. Neighboring property owners should not be burdened with safety risks while standing upon their own property. We suggest the following text be added in the section on setbacks:

(7) From tower to property not leased by the developer, 2 times the overall tower-to-blade tip height.

- Balance and science

During the Public Hearing on March 17th, Commissioner Hansell requested "the science" behind the selection of the 2 mile setback recommendation. While BMA agrees that siting standards ought to be supported by sound reasons, it is good to remember that "science" doesn't do a very good job of placing a value on a rural life style. How do you BALANCE the value of a traditional life style on your own property versus the adverse effects which "bleed over" from your neighbor's property as he engages in activities which provide income? We would remind the Commissioners that during the discussion in the morning regarding proposed text in the Development Codes to manage the use of surplus Cargo Containers as storage structures, there was no call for "the science" to support the proposed code language. There was however, discussion regarding

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finding the proper BALANCE between one citizen's desire to use low cost, secure, cargo containers on his property against another citizen's desire to not be subjected to significant negative effects by his neighbor's actions.

- Cumulative effects

BMA remains concerned that the cumulative adverse effects of wind energy development are not being adequately regulated by existing standards. See the attached map, "CumulativeProjectsV4.pdf" to review the relationship of the various wind projects in the north part of the county. Each project has been reviewed based upon ***only*** its own "footprint", without effective analysis of the interactions/relationships between the projects. A prime example is illustrated on the map – the 36db noise gradient line on the Iberdrola map crosses through multiple turbine strings on multiple projects!

- Summary/recommendations

1. BMA supports the proposed amendments the Planning Commission unanimously adopted after 2 ½ years of research and we urge the County Commissioners insert item **(7)** mentioned above and to then adopt the proposed amendments.
2. The County should encourage the Department of Energy & the Energy Facility Siting Council to apply the Umatilla County siting standards to all projects they review for siting in Umatilla County.
3. The County should encourage the Department of Energy & the Energy Facility Siting Council to initiate a process to improve the siting standards for wind energy development on a state-wide basis and to use the proposal of the Umatilla County Planning Commission as a model.
4. Request the Planning Commission to continue its work to develop improved siting standards for the face of the Blue Mountains.

Respectfully,

Members of the Blue Mountain Alliance -

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Debbie Kelley
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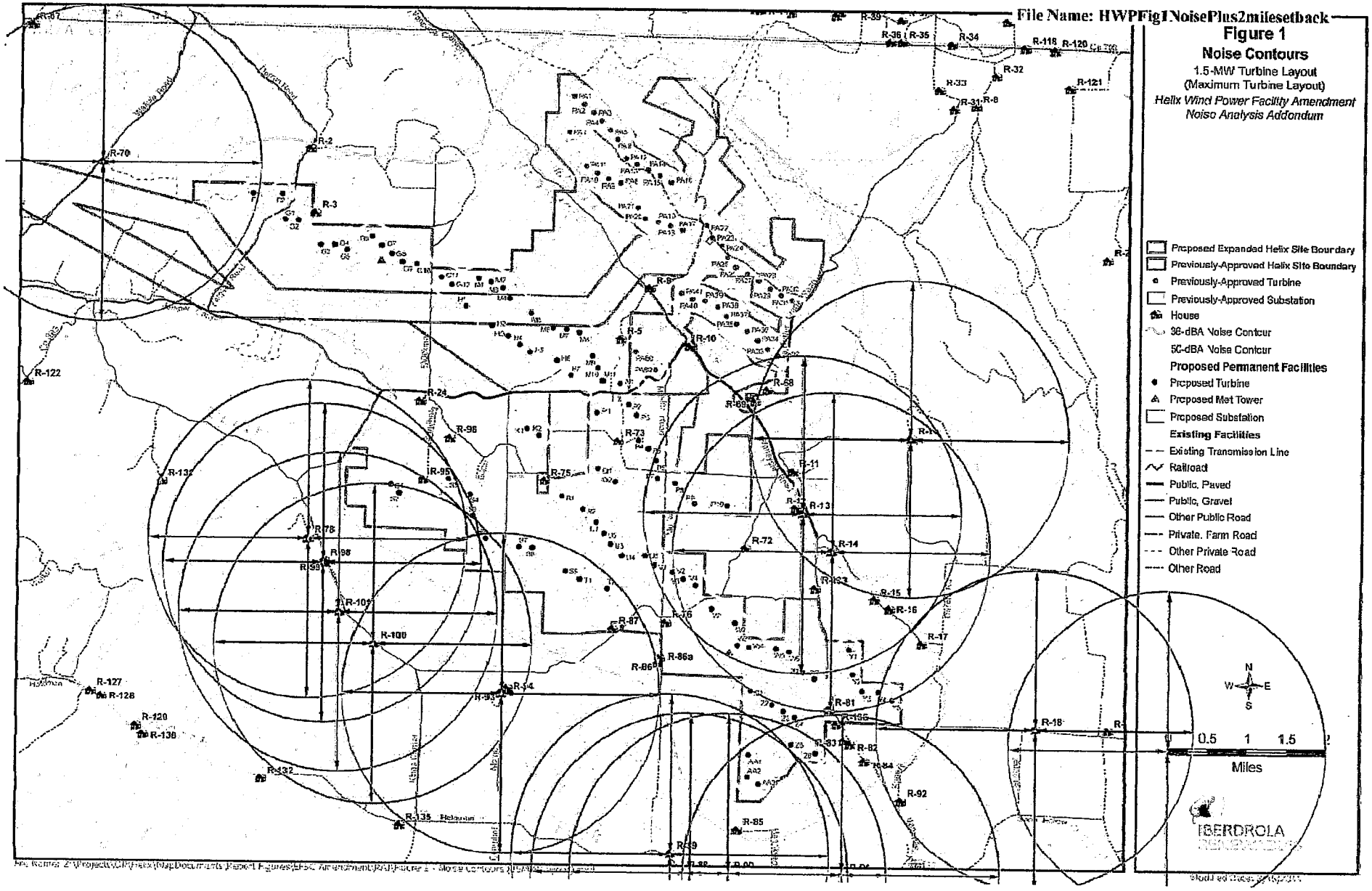
File Name: HWPFig1NoisePlus2milesetback
Figure 1
Noise Contours
1.5-MW Turbine Layout
(Maximum Turbine Layout)
Helix Wind Power Facility Amendment
Noise Analysis Addendum
Proposed Expanded Helix Site Boundary
Previously-Approved Helix Site Boundary
Previously-Approved Turbine
Previously-Approved Substation
House
36-dBA Noise Contour
50-dBA Noise Contour
Proposed Permanent Facilities
Proposed Turbine
Proposed Met Tower
Proposed Substation
Existing Facilities
Existing Transmission Line
Railroad
Public, Paved
Public, Gravel
Other Public Road
Private, Farm Road
Other Private Road
Other Road
N
W
E
S
0.5
1
1.5
Miles
IBERDROLA
R-70
R-2
R-3
R-122
R-24
R-96
R-95
R-73
R-75
R-5
R-10
R-68
R-69
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R-31
R-8
R-121

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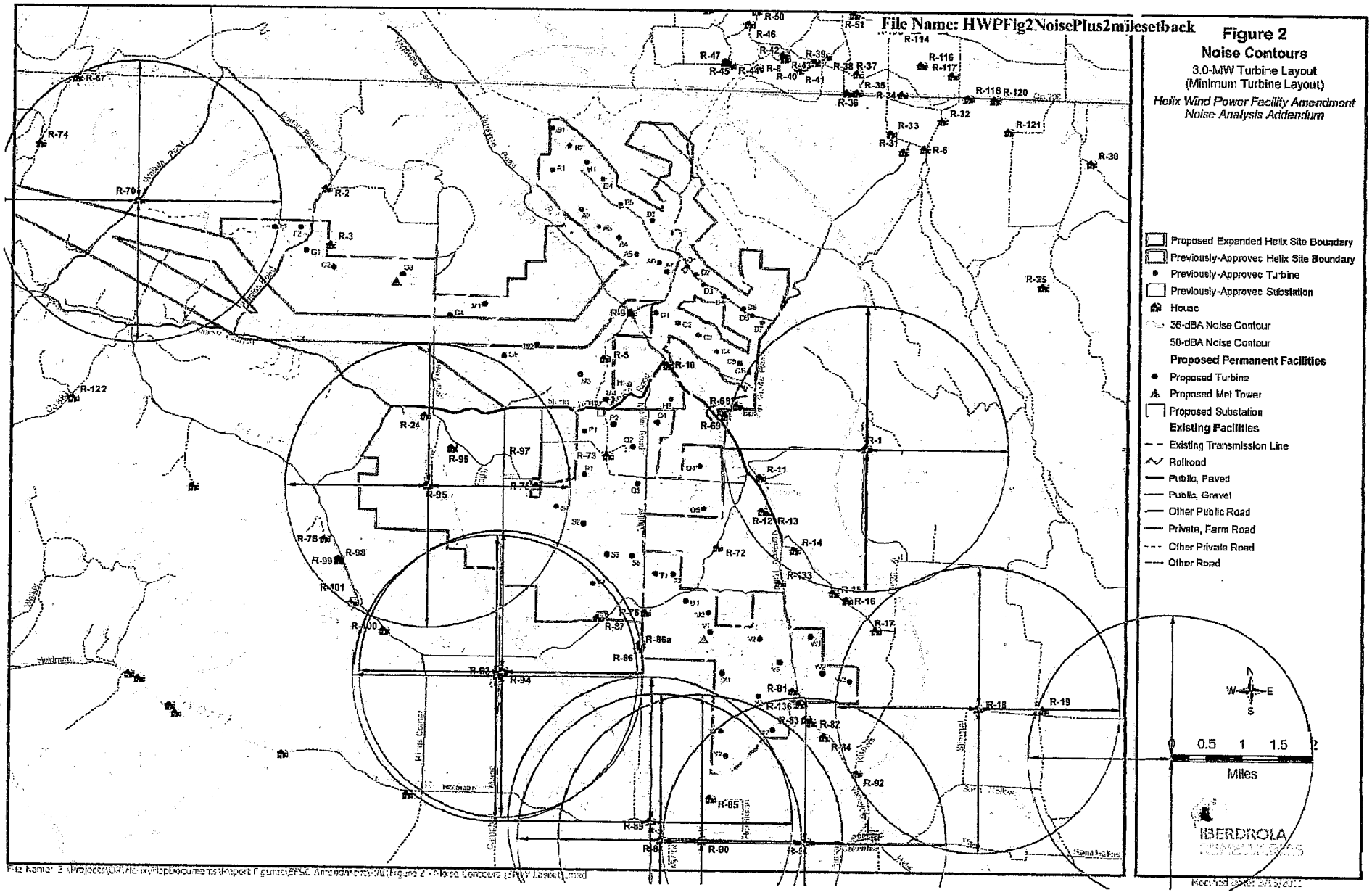
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Figure 2
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3.0-MW Turbine Layout
(Minimum Turbine Layout)
Helix Wind Power Facility Amendment
Noise Analysis Addendum
Proposed Expanded Helix Site Boundary
Previously-Approved Helix Site Boundary
Previously-Approved Turbine
Previously-Approved Substation
House
36-dBA Noise Contour
50-dBA Noise Contour
Proposed Permanent Facilities
Proposed Turbine
Proposed Met Tower
Proposed Substation
Existing Facilities
Existing Transmission Line
Railroad
Public, Paved
Public, Gravel
Other Public Road
Private, Farm Road
Other Private Road
Other Road
0 0.5 1 1.5 2
Miles
IBERDROLA

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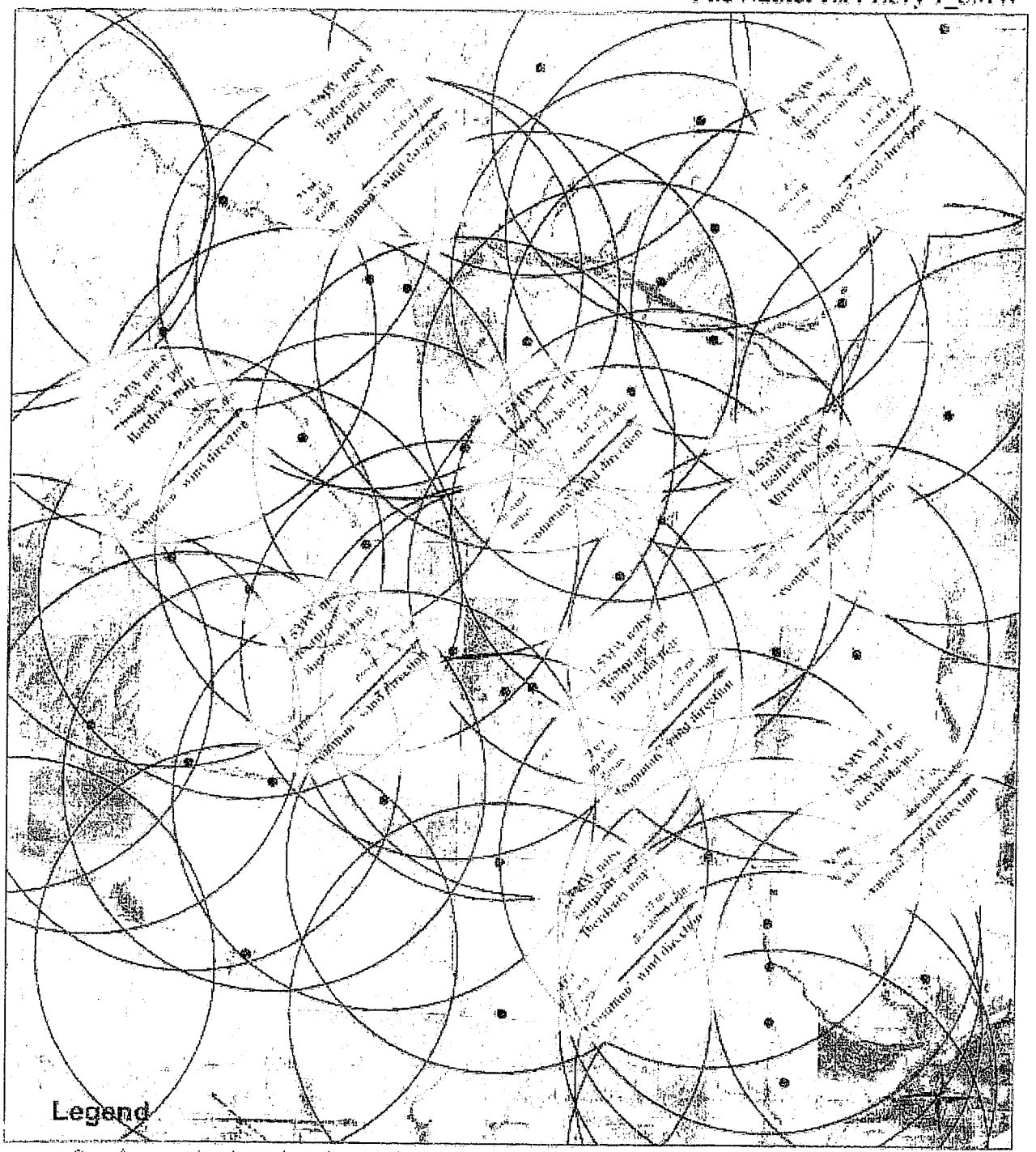
File Name: Ex4 Levy 1_5MW

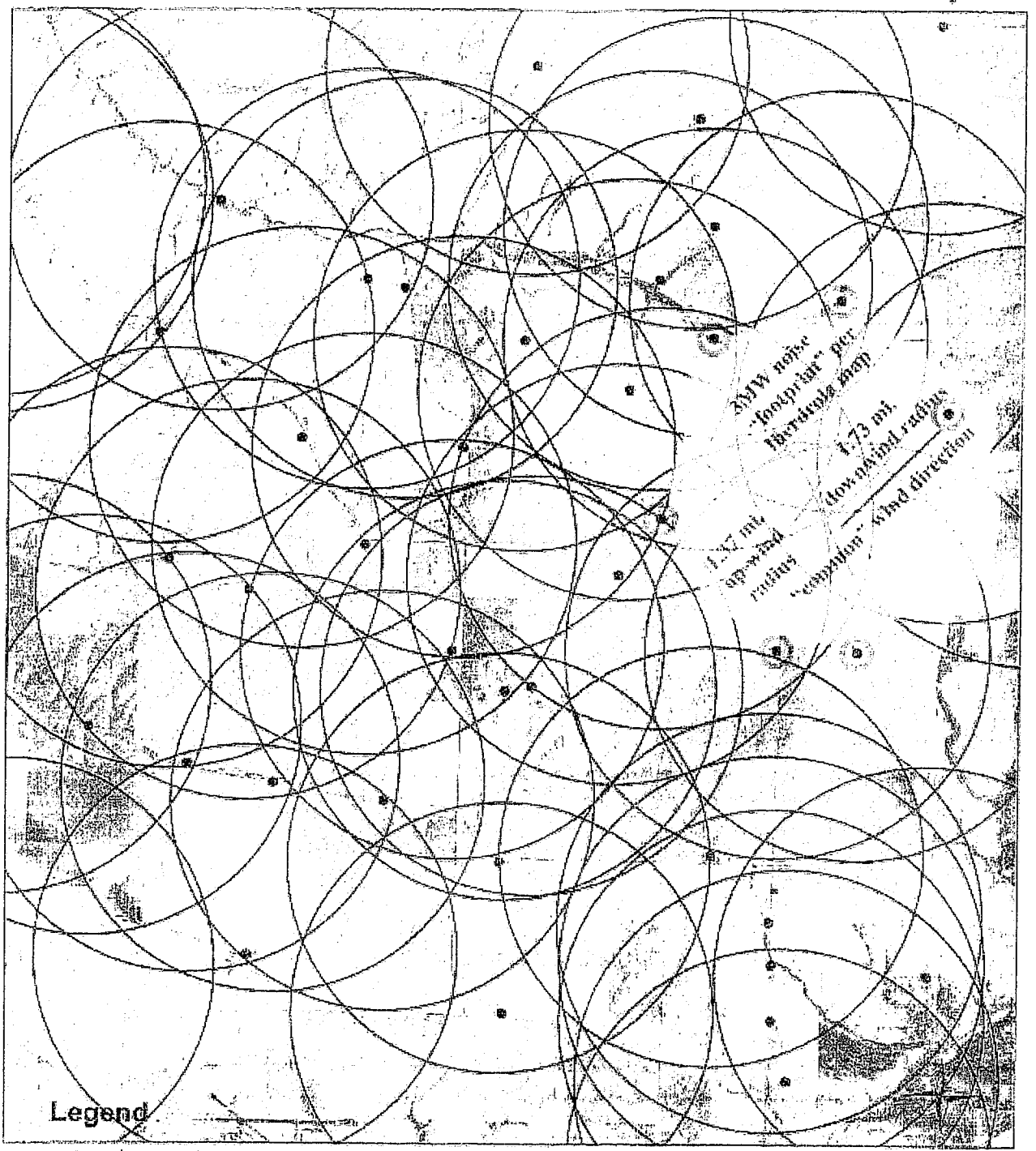


NOTES:

1. **FAA regulations prevent siting of tall structures near airports. Setback requirement of 10,000 feet from runway centerline applies to Pendleton Airport. (perhaps up to 20,000 feet from runway)**
2. **Good faith layman estimate of 36 db noise footprint of 1.5 MW turbine derived from Iberdrola noise map.**
3. **Homes are "at risk" if noise predictions are not correct.**
4. **Standard "turbine string" layout would require noise waivers from most of the above home-owners.**
5. **This is not a good site for commercial wind energy generation - with or without 2 mile setback.**

Exhibit #4

File Name: Ex4 Levy3MW



Radius

○ Miles

arc 2 mile radius

0 0.5 1.0 1.5 | 2.0

1.73 Mi.

NOTES:

1. **FAA regulations prevent siting of tall structures near airports. Setback requirement of 10,000 feet from runway centerline applies to Pendleton Airport. (perhaps up to 20,000 feet from runway)**
2. **Good faith layman estimate of 36+db noise footprint of 3 MW turbine derived from Iberdrola noise map.**
3. **It is not possible to place a 3 MW turbine on this map without signed noise waivers. Example above "covers" 1 home and puts an additional 5 homes at risk.**
4. **This is not a good site for commercial wind energy generation - with or without 2 mile setback.**

Exhibit #4

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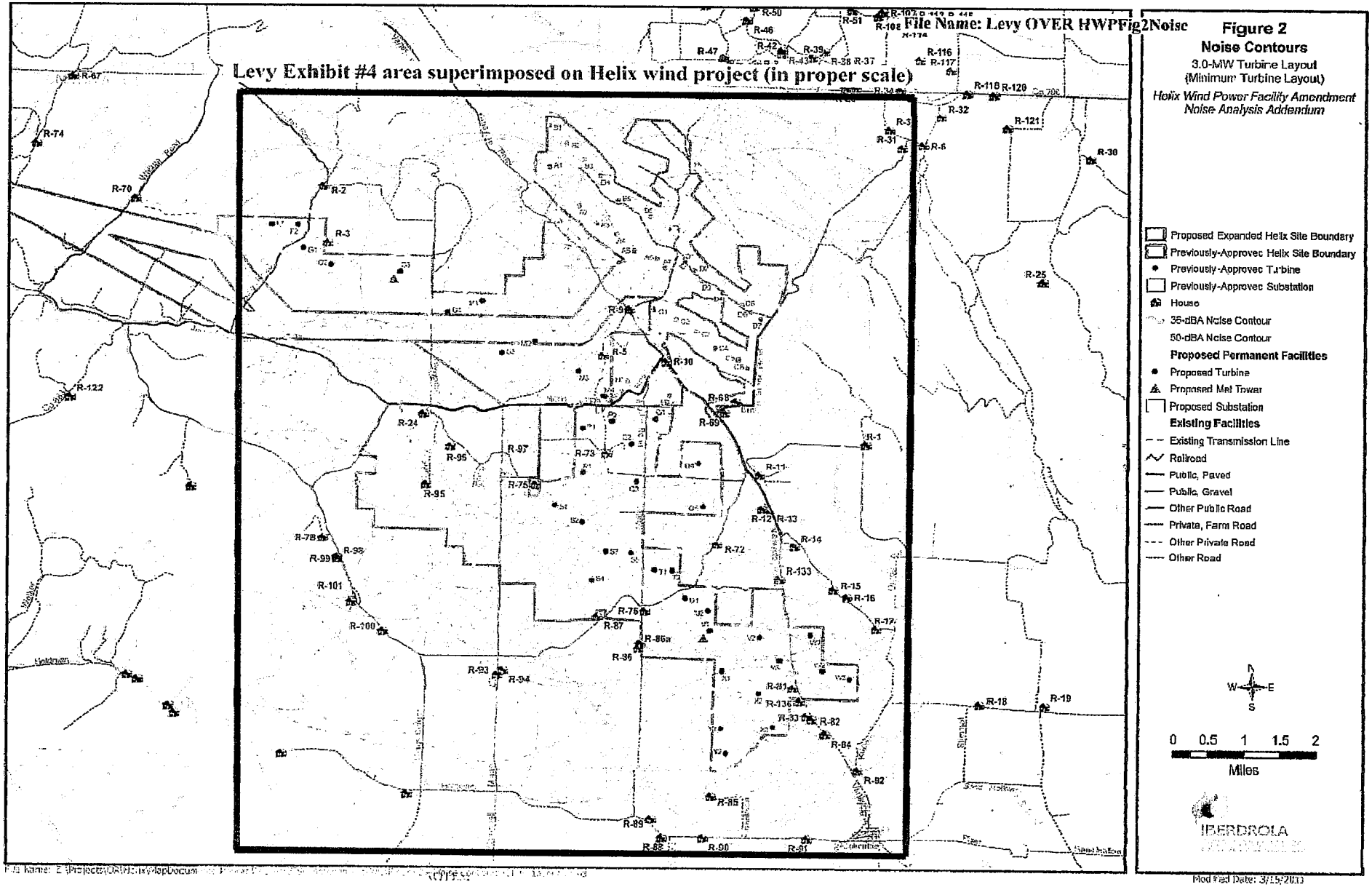
Levy Exhibit #4 area superimposed on Helix wind project (in proper scale)
File Name: Levy OVER HWPFig2Noise
Figure 2
Noise Contours
3.0-MW Turbine Layout
(Minimum Turbine Layout)
Helix Wind Power Facility Amendment
Noise Analysis Addendum
Proposed Expanded Helix Site Boundary
Previously-Approved Helix Site Boundary
Previously-Approved Turbine
Previously-Approved Substation
House
35-dBA Noise Contour
50-dBA Noise Contour
Proposed Permanent Facilities
Proposed Turbine
Proposed Met Tower
Proposed Substation
Existing Facilities
Existing Transmission Line
Railroad
Public, Paved
Public, Gravel
Other Public Road
Private, Farm Road
Other Private Road
Other Road
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S
0 0.5 1 1.5 2
Miles
IBERDROLA
Mod Fied Date: 3/15/2011

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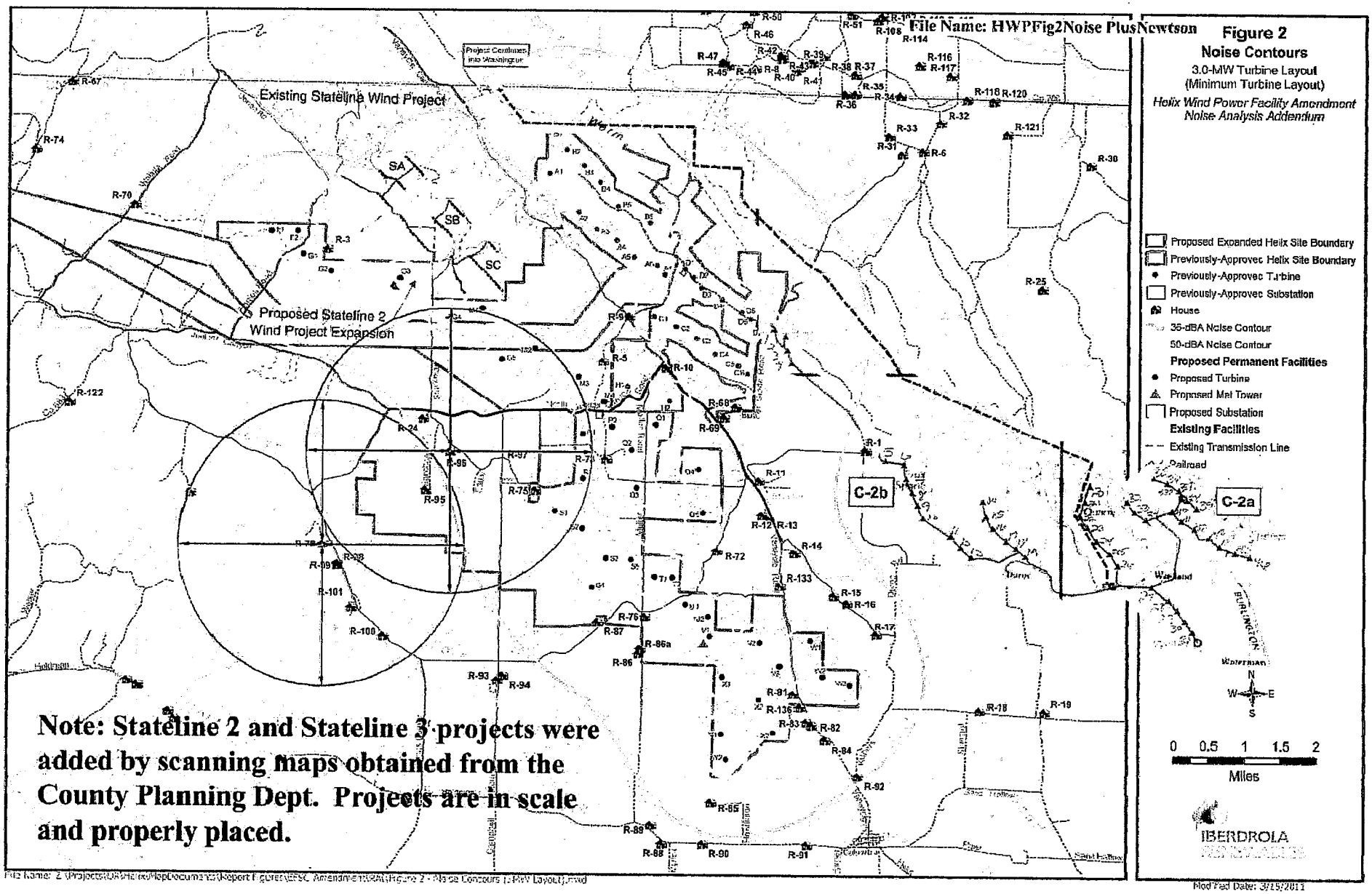

Modified Date: 3/15/2011

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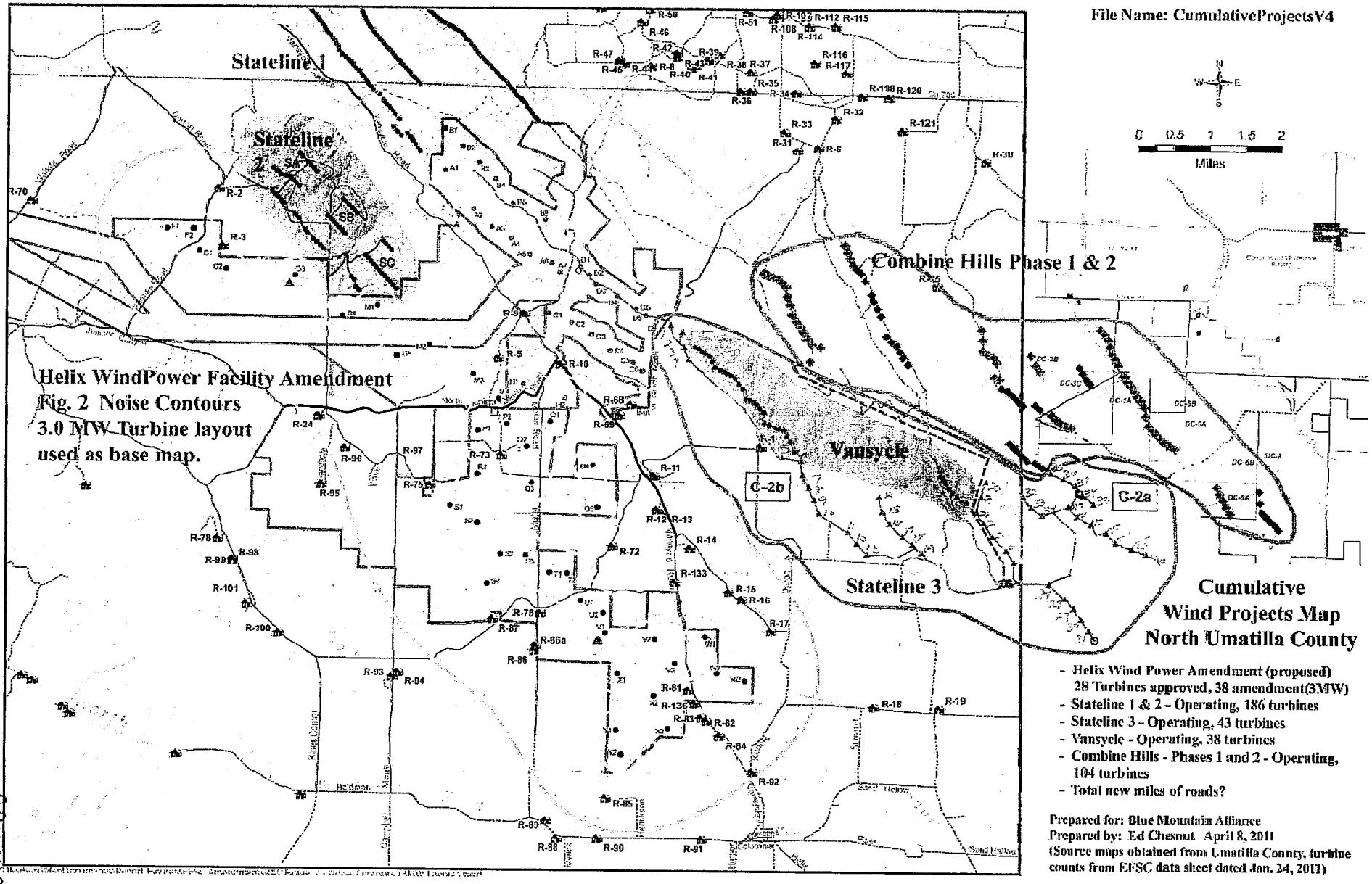
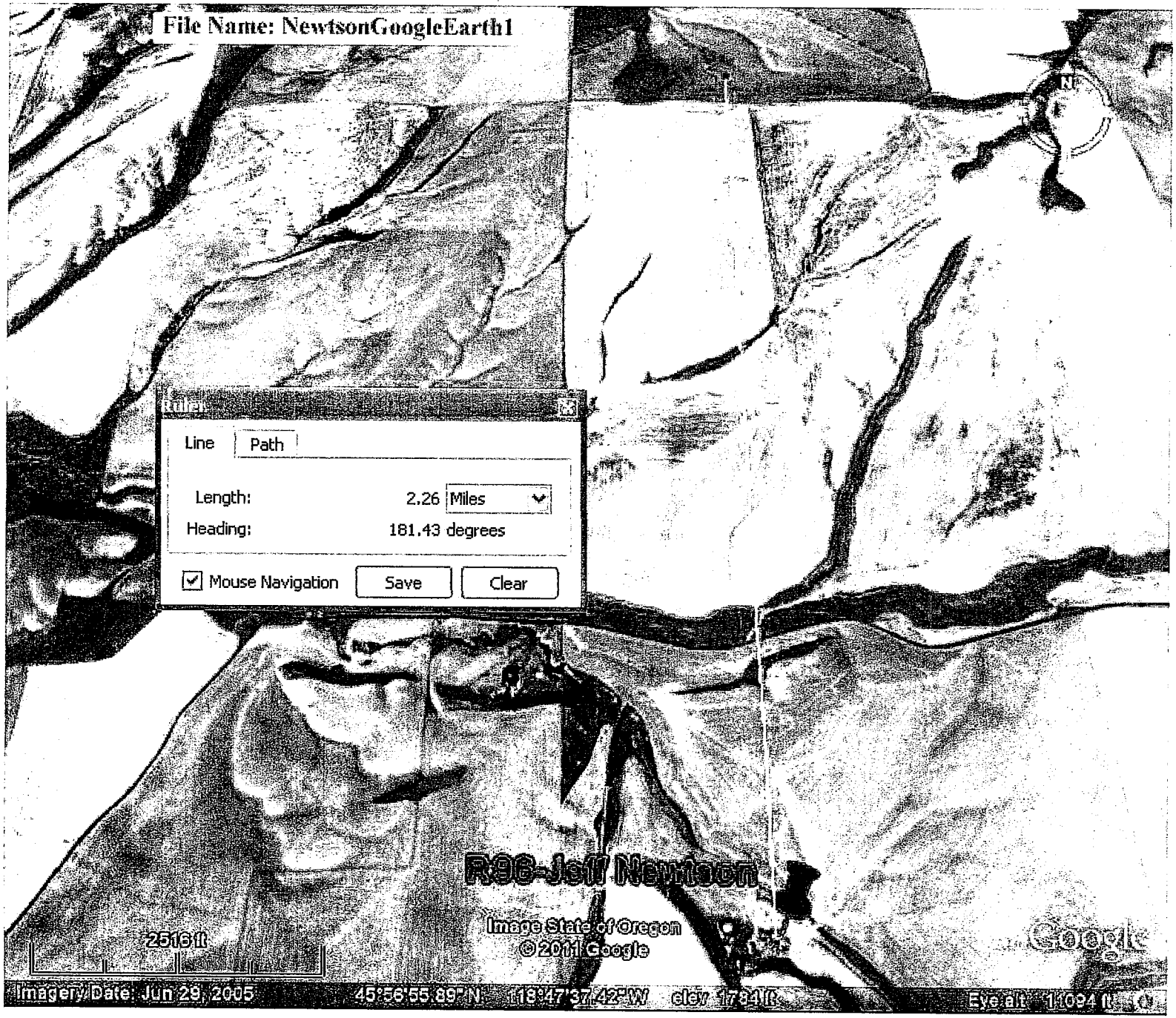

Stateline 1
Stateline 2
SA
SB
SC
Combine Hills Phase 1 & 2
Vansycle
C-2b
C-2a
Stateline 3
Helix WindPower Facility Amendment
Fig. 2 Noise Contours
3.0 MW Turbine layout
used as base map.
File Name: CumulativeProjectsV4
N
W
E
S
0 0.5 1 1.5 2
Miles
Cumulative
Wind Projects Map
North Umatilla County
- Helix Wind Power Amendment (proposed) 28 Turbines approved, 38 amendment(3MW)
- Stateline 1 & 2 - Operating, 186 turbines
- Stateline 3 - Operating, 43 turbines
- Vansycle - Operating, 38 turbines
- Combine Hills - Phases 1 and 2 - Operating, 104 turbines
- Total new miles of roads?
Prepared for: Blue Mountain Alliance
Prepared by: Ed Chesnut April 8, 2011
(Source maps obtained from Umatilla County, turbine counts from EFSC data sheet dated Jan. 24, 2011)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Ruler
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Save
Clear
RGG-Jeff Newtson
Image State of Oregon
© 2011 Google
2516 ft
Google
Imagery Date: Jun 29, 2005
45°56'55.89"N 118°47'37.42"W elev 1784 ft
Eye alt 11094 ft

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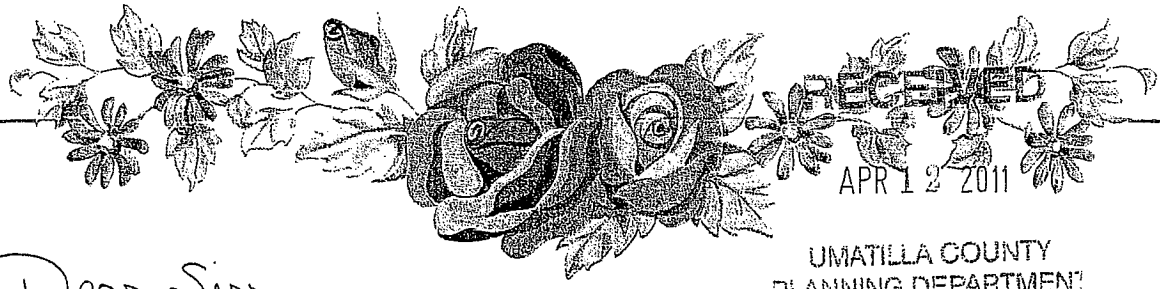

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APR 12 2011
UMATILLA COUNTY
PLANNING DEPARTMENT

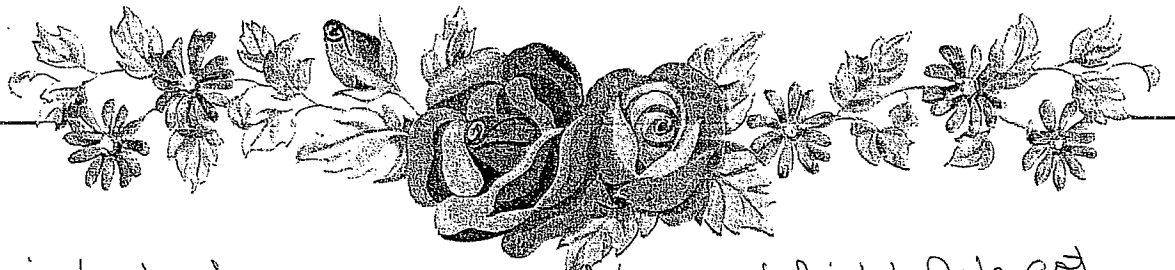
Dear Sirs,

Hi, my relatives moved out here after the civil war and homesteaded in the Blue Mountains, over the years the property has been passed down through the generations.

Ever since I was a little girl I was told by my grandfather and father how great it was to own land, that you could always make a living. First they farmed - things change, then timber and logging - thing change Now we use it for grazing. You can no longer make a living on the property - things change. Wind-turbons have come along and I have signed up.

Next we had town meetings to hear from the public, I was disappointed to find out that it was just to hear from the people who were against them. I felt that the landowners never had a chance to speak up. I feel the landowners and the wind mill developers have been ignored.

As far as the scenery and neighbors go (which seem to be the big issue) - things change. Remember when street lights went up in town? Everyone hated them, now



just about everyone have big yard lights. We got used to them along with radio and cell towers. I could sit here and write page after page, like Mr. Reeder, and argue every point with them. I could tell you all the benefits of the wind towers but you should already know what they are, at least I hope you do!

Times are tough and towers will be built, if not in this county then another. It is time to change!

Barbara Clutter

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Commissioners

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APR 12 2011

UMATILLA COUNTY
PLANNING DEPARTMENT

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Ken-Ioa Schieve
53798 Little Dry Ck Rd
Weston, Or 97886

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Dear Sirs;

Thank you for continually reading our letter.

The intent of the planning process: Says to provide fairness and unbiased outcome and equity.

We are pretty sure that there is any fairness or unbiased reasoning in the planning commission under the presentation of Mr Reeder.

Also we were at all the meetings and there wasn't hardly any input from the other planning commission members.

A lot of the criticism of the wind towers have been taken care of by wind companies: For instance;

(1) Weed control, written in to contracts, weeds will be taken care of along roads, towers and structures.

(2) new and old road and bridges used by wind companies will be maintained.

(3) Wildlife: Seems that we think animals of all kinds are brainless; when something new appears the animal life are leary, curious then accepting and adapting. Animal life includes deer, elk bear, cattle, sheep goats, horses and animals down to the mouse.

(4) Noise: We've been around, under & in wind towers. We were able to carry on conversations at all times. Noise is every where; People build near freeways, airports and huge intertainment structures. Seems humans are not only adaptible forms of life that can

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live with all kinds of technology. Also their health is not harmed or in jeopardy. People adapt.

To repeat noise is everywhere People also build next to roaring rivers, water falls the ocean to see and hear the noise. They say its soothing. We do too.

We have a seasonal creek and we look forward to Spring and the roar or noise of fast moving waters.

We are old enough to remember when the electric poles & lines were going up. They were unsightly, supposably dangerous; dangerous to plants, animals and people; but no one wants to get rid of hiways of electricity now.

(5) Ground vibration: in streams;

a Waters & streams, creeks etc run in canyons valleys and low lands, not on ridges where the wind blows and towers are built, so vibrations are nil. Also moving waters can cause vibrations to begin with rocks tumbling etc, not the turbines on ridges.

(6) Impacts - For the proposed wind farm on the Blue Mountains and the owners of the land. Most of the land is not what you call farm land - its steep rocky - no crops except pasture, (dry land pasture) trees or recreation, so there's not much profit after taxes. So a turbine or two would be a benifit to that owner. His contract covers practically every aspect of your perposals except sitings which he'll commiett later

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on ~~it~~ this letter.

The income from the turbines will be subject to taxes, which will benefit the County, (the whole County including Milton Freewater) schools, fire protection, water and infrastructure for all of ~~Umatilla~~ Umatilla County.

We as landowners, we really feel this whole process is stacked against us. Mr Reeder has said many things not backed up by facts only book writers opinions.

On the siting of the towers we believe ~~1~~ 1/2 mile is a reasonable measure from any home.

But and this is a big but all the planning + discussions will be of no valve if the proposed sitings come to fruitation there will be no weird towers on the Blue Mountains and thats what the opposition wants.

So please really study the pros and cons, with the economy the way it is, we really need this new income ~~except~~ instead of higher taxes (unacceptable) for the County (roads, fire, schools, medical and levees) and I'm sure if we (that includes all of us) study the problems they can be solved and the rights of all will contribute to all peoples of the County.

00003346

Thank you

Yours Ida Schieve

#94

Gunder Terjeson and Kirk Terjeson (Helix, Oregon) April 7, 2011

To: EFSC, Umatilla County Commissioners, Umatilla County Planning Commission:

We are writing this letter in support of the Helix Wind Power Facility Amendment. Some of our ground is enrolled in the original siting of the Helix Wind Power Facility. Although we have chosen not to enroll additional ground into the amended site, we would like to voice our support for this amendment and also to retain the current noise easement setback regulations.

Kirk and I did not know of the Feb. 24th Umatilla Co. Planning Commission meeting or the Mar. 17th Umatilla Co. Board of Commissioners meeting. We became aware of comments and concerns made by a few people describing the negative aspects of wind energy projects. Kirk and I farm and both have houses close to the Vancycle Ridge Wind project and have not experienced any of the problems stated in the Feb. or March meetings. To become better informed, Kirk traveled to the EFSC meeting on March 25th in The Dalles.

Kirk also met with Clinton Reeder, a member of the Umatilla County Planning Commission. Mr. Reeder has provided considerable research to the Commissioners and the public concerning the Helix Wind Power Facility Amendment. Unfortunately, for being in a position of influence, Mr. Reeder has misrepresented some key facts and important issues.

1) Setback Regulations: Mr. Reeder keeps claiming that the current setback for a rural home is ¼ of a mile and that the landowner is stuck with this distance. This is not true. The Helix Wind Power Facility Amendment will comply with EFSC conditions 100-102 which is a much larger setback from non participating rural residences than the 1320 ft. required by EFSC condition 43. (See attachment 1 from Chase Whitney of Iberdrola Renewables.) Because the project must demonstrate compliance with DEQ noise rules, distances from turbine strings to non-participating homes would range from approximately 3800 to 8500 feet (0.7 to 1.6 miles) based on a turbine with maximum sound power level of 106 dBA.
2) The Oregon Department of Environmental Quality has designated 36 decibels as the noise limit that wind projects can generate at nearby homes. A two mile setback does not address larger turbines in the future, while the current EFSC conditions do. What research was done to come up with the proposed arbitrary 2 mile setback? We farm within 1/8 mile of a string of turbines, have one household and our place of business approximately 1 mile from a string of turbines and have not noticed any ill effects or distractions . They have become a part of the landscape. The Umatilla Co. Planning Commission, with Mr. Reeder's input, is proposing a 2 mile setback. A two mile setback may virtually end wind projects in Eastern Oregon as not many places have an area that does not have a dwelling on it in that distance. We feel the current regulations are more than sufficient. They protect land owners with the distance conditions that are approved by EFSC and decibel levels approved by the Oregon Department of Environmental Quality while allowing wind developers stretches of land to build longer strings of turbines.

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3) Flashing Red Lights: Mr. Reeder claims there are flashing red lights on every turbine. This is not so. The FAA regulates how many lights are needed. I can see 10 turbines from my house and never have had any issues with the lights at night. (There are 3 red lights out of the 10 turbines that I can see from my residence).
4) Wildlife: The elk and upland bird population have increased since the installation of turbines on the Stateline wind projects in our area. The Oregon Department of Fish and Wildlife have now issued general season elk tags to the public. The elk herd has increased in size to the point where ODFW has started to issue crop damage elk tags to local area landowners. The mule deer population has remained constant.
5) Property and Land Values: We have been reading in the Planning Commissions' minutes and the East Oregonian, how wind developments are hurting property values. Mr. Reeder says this is a very important issue and needs to be addressed by putting in a two mile setback. With current EFSC setbacks, we are aware of only one house sale since the Helix Wind Project began and its value had increased. What research has been done to guarantee that values will increase any more with a two mile setback?

   The only wheat ground that we are aware of that has been sold in the last three years, in the Helix Wind Project area, was sold before the Helix Wind Power Facility started. Even then, this ground was advertised with a sales stipulation, that the wind rights or portion of the wind rights were not for sale with the land. WIND has become a valuable commodity!
6) Community Discord: Mr. Reeder and Mr. Givens are painting a picture of a community divided. There are different points of view concerning the Helix Wind Project. Whatever the outcome, not everyone is going to be pleased with the results. It is not unlike other community hot topics, whether it is the school district, city issues, bond issues...change causes controversy, but eventually these issues are resolved and life goes on.
7) Clinton Reeder is a knowledgeable man. However, we feel he has not represented both sides of the wind issue fairly. Just a few of the positive benefits are:

   -Clean Energy

   -New Jobs: 100 megawatt project: 6-10 permanent employees
   200 megawatt project: 6-17 permanent employees
   -SIP to area communities.
   -Additional tax revenues for the county.
   - Financial benefits to the landowners involved.
   -Increased land values.
   -Improved roads for farmers.
   -Benefit to local businesses
   -Supplemental income for Farmers
   -Benefits for the Helix School District
   -HELP

To help understand the financial contributions to the county and state, we asked Paul Chalmers of the Umatilla County Tax Assessors Office to provide us with some numbers. For the time period of May 5, 2002 through March 17, 2011, Florida Power & Light, Nextera, & Combine Hill II have made available $718,633.51 in "Community Service Fees", ("HELP" to the Helix Community). (See attachment 2)

From 2002 through 2010, Umatilla County has received tax revenues totaling $11,388,551.00 from area wind projects. (See attachment 3)

Mr. Chalmers said for the 2010-2011 tax year, that without wind, there would be an assessed value increase of 1%. With wind, there would be an assessed value increase of 3.4%. (See attachment 3)

These are substantial amounts of much needed revenues for our local schools and tax districts.

Around 1999 the first Vansycle Ridge Wind Farm turbines went up. There were 38 of the .66 MW towers. They have since amended the project with larger 2.3MW turbines. While we may not have been wild about them at first being installed, (It's that change thing again), we had no objection to our neighbors having them installed on their ground. Now 12 years later, we feel it has been a positive industry for our community. We farm and live close to these turbines and noise has never been an issue. Even during our harvest lunch break, where we eat outside next to our combines, we are not far from some of the turbines and our harvest crews have never voiced a concern about the sound of the turbines. Kirk asked his kids, now 19 and 17 years old, if they had heard the turbine noise while growing up at their house about 1 mile away from the turbines, and both responded "no".

While we would have turbines on some of our ground for the initial phase of this project, Kirk and I decided not to enroll in the Helix Wind Facility Amendment. We have not signed noise easements for our personal residences, but feel the current FSEC guidelines are more than adequate to protect our quality of life where we live. Also, by not enrolling our 1300 acres, we have buffered six additional families that would have had turbines closer to their homes had we signed. Two of these families who are not in favor of the current noise easements, will gain setback as a result of this.

Another point that gets buried in this discussion of the Helix Wind Power Facility is that PPM, now Iberdrola Renewables, has followed the guidelines and regulations put forth by the state and local governments to get to this stage. They have spent a considerable amount of money in state and county planning, historical , cultural, avian, and wildlife studies to name a few. Iberdrola has invested a substantial amount of time and capital in this project while following the current state and local government guidelines and regulations.

Kirk and I have lived in the Helix area all our lives. Our Grandfather and relatives homesteaded this ground in 1888. Our fathers, aunts and uncles have helped to maintain this farm for almost 125 years. There have been many changes in farming and the landscape in those years. Some have been welcomed while others took some getting used to. The number of farms, in our small area of Helix, have dwindled since Kirk and I took over our farm 30 years ago. There are a small number of opportunities for communities our size to increase the revenues for dry land farmers, while also gaining revenues for the tax districts and school in Helix. We hope to be able to pass on the tradition of farming to our family and

the opportunity that will be provided by the Helix Wind Power Facility Amendment can help in reaching that goal.

To conclude, we feel there are sufficient regulations in place provided by EFSC and Umatilla County to vote on the Helix Wind Power Facility Amendment without any further delay. Even with renewable energy being mandated by Federal and State government agencies, we would not be in favor of the Helix Wind Project if we felt our rights were not being protected. Though we are not participating in the Helix Amendment, we feel strongly that we, along with the Helix Community and Umatilla County will benefit from it being passed. Wind energy has been a part of the Helix landscape for 12 years. It has provided jobs and revenues for Umatilla County. The Helix Wind Power Facility Amendment is an opportunity to continue this. We understand that the progress made in the wind energy industry has not been welcomed by everyone. We believe that in the Helix area you will find a majority of people have accepted this change as a positive one. We hope Mr. Reeder will take into consideration all the positive aspects of past wind projects, along with the benefits of the future Helix Wind Power Facility Amendment. There are also specific facts concerning the Helix Wind Facility Project that, if he was not aware of, need to be taken into account.

Thank You.

Gunder Terjeson and Kirk Terjeson

attachment 1

From: Whitney, Chase
Sent: Tuesday, April 05, 2011 1:10 PM
To: Carol Johnson
Cc: Tamra Mabbott; Clinton B. Reeder; Parsons, Sara McMahon; Mark.Bastasch@CH2M.com; ERALBRICH@stoel.com; DEPILIPPI@stoel.com
Subject: RE: Helix Wind Project Setbacks

Carol,

The Helix project will comply with EFSC conditions 100-102 copied below, which will result in a much larger setback from non-participating rural residences than the 1,320 ft required by EFSC condition 43. Because the project must demonstrate compliance with the DEQ noise rules, distances from turbine strings to non-participating homes would range from approximately 3800 to 8500 feet (0.7 to 1.6 miles) based on a turbine with maximum sound power level of 106 dBA. This number depends on a variety of factors, such as turbine maximum sound power level as well as the number and location of turbines in proximity to the residence. It is for these reasons that EFSC requires a detailed site specific analysis prior to construction to demonstrate compliance with the DEQ noise rules, as a standard setback distance is not sufficiently robust to ensure compliance with the restrictive DEQ noise rules at rural residences. While the resulting setback from a rural home to a string of towers is likely greater than the setback to a single tower, there is no hard and fast setback distance for rural homes from strings as compared to single towers, EFSC and DEQ rules recognize that a more rigorous process is required based on the various factors described above

43	Setbacks	The certificate holder shall construct all facility components in compliance with the following setback requirements: (a) All facility components must be at least 3,520 feet from the property line of properties zoned residential use or designated in the Umatilla County Comprehensive Plan as residential. (b) Where (a) does not apply, the certificate holder shall maintain a minimum distance of 110-percent of maximum blade tip height, measured from the centerline of the turbine tower to the nearest edge of any public road right-of-way. The certificate holder shall assume a minimum right-of-way width of 60 feet. (c) Where (a) does not apply, the certificate holder shall maintain a minimum distance of 1,320 feet, measured from the centerline of the turbine tower to the center of the nearest residence existing at the time of tower construction. (d) Where (a) does not apply, the certificate holder shall maintain a minimum distance of 110-percent of maximum blade tip height, measured from the centerline of the turbine tower to the nearest boundary of the certificate holder's lease area.
86	Transmission Lines	The certificate holder shall take reasonable steps to reduce or manage human exposure to electromagnetic fields, including but not limited to:
		(a) Constructing all aboveground transmission lines at least 200 feet from any residence or other occupied structure, measured from the centerline of the transmission line.
		etc
100	Noise Abatement	To reduce construction noise impacts at nearby residences, the certificate holder shall:
		(a) Confine the noisiest operation of heavy construction equipment to the daylight hours.
		(b) Require contractors to install and maintain exhaust mufflers on all combustion engine-powered equipment; and
		(c) Establish a complaint response system at the construction manager's office to address noise complaints.
101	Turbine Noise	Before beginning construction, the certificate holder shall provide to the Department:
		(a) Information that identifies the final design locations of all turbines to be built at the facility.
		(b) The maximum sound power level for the substation transformers and the maximum sound power level and octave band data for the turbines selected for the facility based on manufacturers' warranties or confirmed by other means acceptable to the Department.
		(c) The results of noise analysis of the facility to be built according to the final design performed in a manner consistent with the requirements of OAR 340-035-0035(1)(b)(B)(iii) (IV) and (VI) demonstrating to the satisfaction of the Department that the total noise generated by the facility (including the noise from turbines and substation transformers) would meet the ambient degradation test and maximum allowable test at the appropriate measurement point for all potentially-affected noise sensitive properties.
		(d) For each noise-sensitive property where the certificate holder relies on a noise waiver to demonstrate compliance in accordance with OAR 340-035-0035(1)(b)(B)(iii)(III), a copy of the a legally effective easement or real covenant pursuant to which the owner of the property authorizes the certificate holder's operation of the facility to increase ambient statistical noise levels L10 and L50 by more than 10 dBA at the appropriate measurement point. The legally-effective easement or real covenant must include a legal description of the burdened property (the noise sensitive property) be

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attachment 2 (page 1) "Community Service FEE "Included"

1603 - 1003 - HELP

Date	Description	Amount In	Amount Out	Balance
05/21/02	Contribution #1	$ 50,000.00		$ 50,000.00
06/30/02	Interest Earned	$ 42.90		$ 50,042.90
11/08/02	Helix School - Doors/Hot Water		$ 25,000.00	$ 25,042.90
12/12/02	Helix - Roof		$ 25,000.00	$ 42.90
01/30/03	Contribution #2	$ 50,000.00		$ 50,042.90
05/22/03	Helix - Roof		$ 6,375.75	$ 43,667.15
06/30/03	Interest Earned	$ 700.85		$ 44,368.00
08/12/03	Helix School		$ 25,000.00	$ 19,368.00
12/18/03	Helix		$ 13,212.00	$ 6,156.00
12/31/03	Contribution #3	$ 50,000.00		$ 56,156.00
01/08/04	Helix		$ 906.14	$ 55,249.86
06/30/04	Interest Earned	$ 488.62		$ 55,738.48
08/31/04	Helix Return Funds	$ 8,900.00		$ 64,638.48
12/29/04	Contribution #4	$ 50,000.00		$ 114,638.48
01/27/05	Helix		$ 1,405.11	$ 113,233.37
03/03/05	Helix School		$ 25,000.00	$ 88,233.37
03/03/05	Helix School		$ 8,900.00	$ 79,333.37
06/30/05	Interest Earned	$ 1,783.17		$ 81,116.54
09/01/05	Helix - Sidewalk		$ 23,211.00	$ 57,905.54
11/10/05	Helix - Sidewalk		$ 27,076.00	$ 30,829.54
12/30/05	Contribution #5	$ 50,000.00		$ 80,829.54
05/31/06	HELP Correction	$ 999.90		$ 81,829.44
05/31/06	HELP Correction		$ 999.90	$ 80,829.54
06/30/06	Interest Earned	$ 2,968.95		$ 83,798.49
12/28/06	Helix		$ 9,252.23	$ 74,546.26
12/29/06	Contribution #6	$ 50,000.00		$ 124,546.26
02/22/07	Helix - Flood		$ 8,391.75	$ 116,154.51
03/08/07	Helix School		$ 22,450.11	$ 93,704.40
06/21/07	Helix School		$ 21,870.00	$ 71,834.40
06/30/07	Interest Earned	$ 5,389.46		$ 77,223.86
08/24/07	Helix - FWDP		$ 2,072.45	$ 75,151.41
10/11/07	Helix		$ 3,292.36	$ 71,859.05
10/18/07	Helix - Park		$ 25,731.44	$ 46,127.61
10/25/07	Hermiston Chamber - Farm Fair		$ 150.00	$ 45,977.61
12/26/07	Contribution #7	$ 50,000.00		$ 95,977.61
06/12/08	Helix School		$ 5,679.89	$ 90,297.72
06/12/08	Helix School		$ 24,881.17	$ 65,416.55
06/30/08	Interest Earned	$ 3,917.84		$ 69,334.39
12/30/08	Contribution #8	$ 50,000.00		$ 119,334.39
12/31/08	Interest Earned	$ 2,319.68		$ 121,654.07
02/12/09	Correction AWERE		$ 999.90	$ 120,654.17
02/12/09	Correction BCC - Farm fair	$ 150.00		$ 120,804.17
04/01/09	Helix School Dist Project		$ 23,945.49	$ 96,858.68

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attachment 2 (page 2)

06/29/10	City of HELIX 2010		$ 21,362.73	$	102,284.31
08/26/10	Helix Comm Church		$ 13,325.00	$	88,959.31
12/02/10	Helix 08-09		$ 10,149.35	$	78,809.96
12/22/10	Contribution #10	$ 50,000.00		$	128,809.96
12/30/10	NEXTERA 2010	$ 190,360.50		$	319,170.46
12/30/10	COMBINE HILLS	$ 8,363.30		$	327,533.76
02/17/11	Helix School - Facility 2010		$ 4,490.00	$	323,043.76
02/17/11	Helix School - Kitchen 2010		$ 4,255.74	$	318,788.02
02/17/11	Helix School - Playground 2010		$ 1,500.00	$	317,288.02
02/17/11	Helix School - Technology		$ 14,500.00	$	302,788.02
02/17/11	Helix School - Trees 2010		$ 1,100.00	$	301,688.02
03/17/11	Interest Earned	$ 785.94		$	302,473.96
				$	302,473.96
				$	302,473.96
				$	302,473.96

FPL 10@50,000 $ 500,000.00

COMB. NE HILLS II 2010 8363.30

NEXTERA 2010 190360.50

INTEREST 19909.71

718,633.51

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attachment 3

FOR 2010-11 TAX YEAR
Without Wind = 1% In
With Wind = 3.4% In

WIND POWER COMPARISON

ACCOUNT	YEAR	% of New	VALUE	VALUE PER TOWER	PERCENT CHANGE	TOTAL TAX	COUNTY TAX
158187	2002		68,063,000	540,183		$688,157.78	$193,891.07
FPL VANSYCLE	2003		89,315,000	493,453	91.35%	$907,395.76	$254,431.64
(STATELINE)	2004		88,640,000	489,724	99.24%	$892,179.34	$252,508.77
126 TOWERS @ 660 KW EA FOR 2002 VALUE	2005		83,000,000	458,564	93.64%	$836,731.30	$236,442.10
55 ADDED FOR THE 2003 VALUE	2006		62,580,000	345,746	75.40%	$631,200.67	$178,271.65
CODE AREA 01-02	2007		56,893,000	314,326	90.91%	$572,770.28	$162,071.09
	2008		58,097,000	320,978	102.12%	$584,891.55	$165,500.92
	2009		47,563,000	262,779	81.87%	$478,840.50	$135,492.72
	2010	57.27%	38,979,000	215,354	81.95%	$392,421.08	$111,039.48
						$5,984,588.26	$1,689,649.43
159512	2004		39,996,000	975,512		$392,800.72	$113,936.61
EURUS COMBINE	2005		39,000,000	951,220	97.51%	$381,392.70	$111,099.30
41 TOWERS@ 1 MW ea	2006		32,623,000	795,683	83.65%	$312,759.96	$92,933.14
CODE AREA 07-12	2007		29,176,000	711,610	89.43%	$275,981.62	$83,113.67
	2008		25,896,000	631,610	88.76%	$244,955.44	$73,769.94
	2009		27,020,000	659,024	104.34%	$255,587.58	$76,971.87
	2010	65.46%	26,182,000	638,585	96.90%	$247,660.77	$74,584.66
						$2,111,138.80	$626,409.19
155672	1999		24,700,000	650,000		$251,112.55	$70,362.89
ESI VANSYCLE	2000		24,800,000	652,632	100.40%	$249,056.48	$70,647.76
38 TOWERS @ 660KW ea	2001		23,800,000	626,316	95.97%	$239,013.88	$67,799.06
CODE AREA 01-02	2002		23,000,000	605,263	96.64%	$228,824.01	$65,520.10
	2003		21,811,000	573,974	94.83%	$216,994.80	$62,133.00
	2004		21,620,000	568,947	99.12%	$215,094.57	$61,588.89
	2005		21,000,000	552,632	97.13%	$208,926.27	$59,822.70
	2006		14,104,000	371,158	67.16%	$140,318.86	$40,178.06
	2007		15,127,000	398,079	107.25%	$150,496.56	$43,092.28
	2008		16,560,000	435,789	109.47%	$164,753.29	$47,174.47
	2009		16,972,000	446,632	102.49%	$168,852.22	$48,348.14
	2010	64.78%	16,000,000	421,053	94.27%	$159,181.92	$45,579.20
						$2,392,625.41	$682,246.56
2008 totals			100,553,000			$994,600.28	$286,445.33
2009 totals			91,555,000			$903,280.31	$260,812.73
2010 totals			159,143,000			$1,699,462.61	$453,350.66
TOTAL TAX YTD						**$11,388,551.31**	**$3,220,452.50**

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https://mail.google.com/mail/?ui=2&ik=b19b1aeae7&view=att&th=12f5045de12a07d1&att... 5/7/2011

58

Subject: Re: Helix Wind Power Facility Amendment
From: Tamra Mabbott <Tamra.Mabbott@ucem.us>
Date: Thu, 07 Apr 2011 13:27:02 -0700
To: wade muller <wvmfarm@gmail.com>
CC: john.white@odoe.state.or.us, planning@co.umatilla.or.us, ROBIN SEVERE <severe@wildblue.net>, Heather Haueter <heather@co.umatilla.or.us>, Carol Johnson <carol@co.umatilla.or.us>

Hello Mr. Muller - I want to explain the Planning Office protocol and how we have followed through on your request to distribute this to the Planning Commission and to the Board of Commissioners. If this does not meet your expectations please let me know.

1. An electronic copy was emailed to the Planning Commission. This was sent to the Planning Commission as general information and is not part of a record for any particular proceeding, quasi-judicial or legislative, as there is currently no pending Planning Commission hearing related to wind siting standards.

2. I assumed that you wanted a copy of this email and the Dr. Pierpoint study to be submitted in to the record of the Board of Commissioners. That record being for the UCDO 152.616 (HHH) wind siting standards update. At the Board's March 17th hearing they requested that comments be submitted by April 15th, although they would be able to accept comments until the record is closed. Your submittal (this email and the Pierpoint report) will be printed and forwarded to the Board in their packets prior to their next meeting to discuss the wind standards. The Board has scheduled a work session for May 3rd. The public hearing has been continued to May 12, 2011 at 9:00 am.

Cordially, Tamra

On 4/3/2011 1:28 PM, wade muller wrote:

> Wade & Vicki Muller
> PO Box 340
> 81414 Muller Rd
> Helix, OR 97835
> wvmfarm@gmail.com
>
> 4/3/2011
>
> Mr. White,
>
> I am sending this email as a request for a contested case in regard to the amendment of the Helix Wind Power Facility. In my earlier request for a contested case, I pointed out that the Noise Contour Maps were invalid, due to the exclusion of three residences. This exclusion, I believe, negated their right to be included in discussions leading up to the original permit, and certainly the discussions for this amendment. I also pointed out that the Umatilla County Planning Commission had done extensive research and held public discussions which led to their recommendation of a 2 mile set-back for wind turbines from residences. In the letter dated March 11, 2011 from the Department of Energy it is stated that the certificate holder has submitted corrected noise contour

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maps and revised tables of predicted noise levels. I find it fascinating that this was only accomplished by research done by myself and other residents in the area. It appears from the letter that this, in and of itself, is insufficient to halt this amendment. I do have to say that this strikes me as a rather cavalier response along the lines of "Too bad, so sad" for the residents who had no input on the original permit.

Since the letter from the DOE explains that the Right to Request a Contested Case required under OAR 345-027-0070(6) lists three requirements, I will do my best to address all three.

As you can see above, I have fulfilled item 3.

Item 1, a description of the issues that you contest -

1. The Noise Contour Maps in the original permitting process were invalid, which should result in voiding the original permit, require a re-application for the original certificate, and therefore make the amendment an non-issue.
2. Recent extensive research and hearings completed by the Umatilla Planning Commission show adequate fact and support for not granting this amendment.
3. Recent scientific study shows indisputable evidence of the harmful affects of wind turbine noise, especially in the number and placement of wind turbines

Item 2, statement of the facts that you believe to be at issue -

My earlier email discussed th above issue items 1 and 2, so I would refer you to that earlier email rather than repeat what I had already sent you. The remainder of my email will deal with what I consider to be relevant and ground-breaking, recent research on the effects of wind turbine noise to humans. I would like to refer you to the web address:

http://www.windturbinesyndrome.com/img/WTSbrain-color.pdf

I encourage you to read the entire missive. I will be referring to Dr. Nina Pierpoint's work on Wind Turbine Syndrome extensively because it includes research from a Nobel Peace Lauriate, the New England Journal of Medicine, and numerous other doctors and experts in the field of sound and how it affects humans.

As you can see when you access Dr. Pierpoint's missive, the abstract states,

"Abstract
The latest research, as discussed below, suggests the following mechanism for Wind Turbine Syndrome: air-borne or body-borne low-frequency sound directly stimulates the inner ear, with physiologic responses of
both cochlea (hearing organ) and otolith organs (saccule and utricle—
organs of balance and motion detection).
Research has now proved conclusively that physiologic responses in the cochlea suppress the hearing response to low-frequency sound but still send signals to the brain, signals whose function is, at present, mostly unknown. The physiologic response of the cochlea to turbine noise is also a trigger for tinnitus and the brain-cell-level reorganization that tinnitus represents —reorganization that can have an impact on language
processing and the profound learning processes related to language

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processing.
New research also demonstrates that the "motion-detecting" otolith organs of mammals also respond to air-borne low-frequency sound. Physiologic responses and signals from the otolith organs are known to generate a wide range of brain responses, including dizziness and nausea (seasickness, even without the movement), fear and alerting (startle, wakefulness), and difficulties with visually-based problem-solving.
Increased alerting in the presence of wind turbine noise disturbs sleep, even when people do not recall being awakened. A population-level survey in Maine now shows clear disturbances of sleep and mental wellbeing out to 1400 m (4600 ft) from turbines, with diminishing effects out to 5 km (3 miles). "

According to Dr. Pierpoint, Tinnitus, is a major problem resulting from wind turbine noise. She states that "58% of the adults and older teens in my sample of affected families had tinnitus. In the general population, it's 4%." This is a truly disturbing development when you consider that existing wind turbine sitings were done without this research.

Dr. Pierpoint explains that "Noise exposure, even at relatively low sound levels, fouls up the parts of the brain responsible for figuring out language sounds (what we call language processing), and the parts responsible for understanding and learning and remembering things we hear or read (what we call language-based learning)...Noise exposure, even at low levels that don't damage hearing, can do this." This issue is especially notable when you consider that there are already wind turbine sitings within 3 miles of schools. Once again I urge you to read the entire document presented by Dr. Pierpoint and pay particular attention to this portion.

Dr. Pierpoint also points out that "The symptons of Wind Turbine Syndrome directly mirror the symptom clusters that practicing otolaryngologists have seen for years in patients with balance problems due to vestibular inner ear pathology...Over 90% of my sample of affected people, both adults and children, had cognitive difficulties during wind turbine exposure -- problems that lingered and resolved slowly after exposure ended. These included difficulties with reading, math, spelling, writing, multitasking in kitchen and home, remembering a series of errands, maintaining a train of thought in a telephone conversation, following the plot of a TV show, following recipes, and following directions to put together furniture."

Dr. Pierpoint refers to the work of Dr. Alec Salt that shows that balance disturbance can be related to Wind Turbine Syndrome and actually cause panic, especially during sleep, that effected 2/3 of her adult subjects.

Dr. Pierpoint's summary is as follows:

"Summary
• Wind turbine noise causes tinnitus in many exposed people. Tinnitus at the physiologic level is the result of a change in sound processing by the brain.
• Other types of environmental noise have been shown to impair

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children's learning by changing how they process language sounds. Families exposed to wind turbines noticed deterioration in their children's thinking and learning abilities during exposure. Adults also had problems with thinking, memory, and concentration during exposure.
• Other clinical and brain studies have shown that diminished thinking and performance are tied to malfunctioning of the vestibular portion of the inner ear.
• Distorted balance signaling has a close connection with panic and anxiety in a variety of situations, a linkage that may explain how panic in the night crops up in previously non-panicked but motionsensitive people exposed to wind turbines."

I urge you to read all of Dr. Pierpoints document, but I feel compelled to include her parting remarks:

"It's worth pointing out that, with one notable exception, none of this was done with government or industry or foundation support -- either financial or moral support. Just the opposite, governments (at all levels) and the wind energy industry have actively tried to thwart this research. But -- this pleases me immensely -- it was accomplished despite their opposition...While governments, the wind industry, and its scientific and clinical hirelings, and the media continue to belittle and deny the experience of these individuals -- Lord knows the media is filled with denial, ridicule, and venom (Google "Wind Turbine Syndrome") -- I am reminded, once more, that the physical, mental, social, and financial consequences of this perfectly correctable condition are appalling."

I believe that the research of these notable individuals gives adequate fact to contest the amendment to the Helix Wind Power Facility. This is up to date, verifiable, scientific data. Ignoring this data would lead me to believe that the Umatilla Planning Commission, the Umatilla County Commissioners, EFSC, the DOE, and the State of Oregon are all willing to accept responsibility for future financial compensation resulting from litigation that residents and families of school children, might bring forth due to the physical and mental suffering endured from the effects of Wind Turbine Syndrome.

I would ask that copies of this email and Dr. Pierpoint's missive be distributed to the Umatilla Planning Commission, the Umatilla County Commissioners, and the EFSC siting board. If these entities are not willing to print Dr. Pierpoint's document, with its attached bibliography, please let me know immediately so that I may have copies printed and sent to the respective boards and individuals.

Respectfully Yours,

Wade A. Muller

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Wind Turbine Syndrome & the Brain

Nina Pierpont, MD, PhD

November 15, 2010



*The following is the text of Pierpont's keynote address before the "First International Symposium on the Global Wind Industry and Adverse Health Effects: Loss of Social Justice?" in Picton, Ontario, Canada, October 30, 2010. It is followed by a discussion of several other relevant talks at the symposium by Drs. Alec Salt, Michael Nissenbaum, Christopher Hanning, and Mr. Richard James.

Abstract

The latest research, as discussed below, suggests the following mechanism for Wind Turbine Syndrome: air-borne or body-borne low-frequency sound directly stimulates the inner ear, with physiologic responses of both cochlea (hearing organ) and otolith organs (saccule and utricle—organs of balance and motion detection).

Research has now proved conclusively that physiologic responses in the cochlea suppress the hearing response to low-frequency sound but still send signals to the brain, signals whose function is, at present, mostly unknown. The physiologic response of the cochlea to turbine noise is also a trigger for tinnitus and the brain-cell-level reorganization that tinnitus represents—reorganization that can have an impact on language processing and the profound learning processes related to language processing.

New research also demonstrates that the "motion-detecting" otolith organs of mammals also respond to air-borne low-frequency sound. Physiologic responses and signals from the otolith organs are known to generate a wide range of brain responses, including dizziness and nausea (seasickness, even without the movement), fear and alerting (startle, wakefulness), and difficulties with visually-based problem-solving.

Increased alerting in the presence of wind turbine noise disturbs sleep, even when people do not recall being awakened. A population-level survey in Maine now shows clear disturbances of sleep and mental well-being out to 1400 m (4600 ft) from turbines, with diminishing effects out to 5 km (3 miles).

Sensory systems change brain functioning

I confess I have an odd medical practice. I'm a pediatrician by training, but I'm fascinated by brains and development, and essentially practice psychiatry and child development. I'm interested in how to help children's brains grow well, and, at the other end of the spectrum, in what derails normal brain functioning in normal people—like Wind Turbine Syndrome—and how to get that functioning back on track.

So much of brain function is about the sensory systems—vision, hearing, touch—and what the brain does to take basic sensory signals from all over the body and turn them into a coherent picture of where this particular creature—oneself—is at this particular time, and what needs to happen next to meet its needs. Those needs range from the basic and physiologic—like breathing and pumping blood in the right amounts to the different parts of the body—to complex social and language-based needs, like figuring out what your spouse really meant by that last thing he said. Our sensory systems mediate all of these needs.

Sensory systems change brain functioning. They affect not only what a person or animal feels or thinks at that very moment, but also how that brain will function in the future, even the near future. This is called neuroplasticity, the neural basis of learning, for which Eric Kandel won the Nobel prize in 2000.[1]

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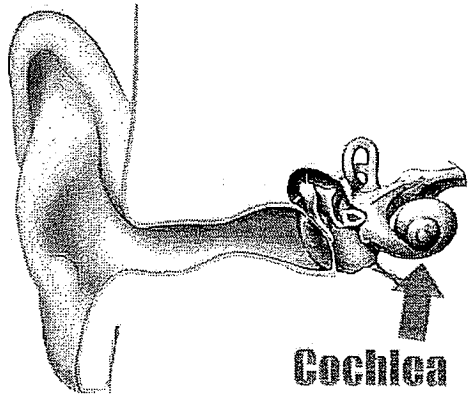
Tinnitus:
The brain makes up sound where no sound exists

Take, for example, tinnitus, or ringing in the ears—an important sensory problem in Wind Turbine Syndrome. Ringing, buzzing, sizzling, or waterfall noises—my study subjects described all of these, sometimes in the head as well as the ears.



58% of the adults and older teens in my sample of affected families had tinnitus. In the general population, it's 4%. People with a prior history of hearing loss or industrial noise exposure were especially likely to get tinnitus, but other people in the study also got it, without these risk factors.

Among people with tinnitus in general, many have damage to their cochlea, the snail-shaped organ of hearing in the inner ear. Because of this damage, many researchers have heretofore thought that tinnitus originates in the cochlea as distorted hearing signals—the cochlea being somehow able to produce nerve signals of sound without the sound being there in the environment.



We are now getting quite a different picture of tinnitus. People with auditory nerves (meaning the nerve from the cochlea to the brain) that have been completely cut (for example, because of a tumor on the nerve) also have tinnitus, although, again, there is no input from the cochlea to the brain at all.

Recently, functional imaging studies (like MRI or PET scans) of people with tinnitus have supported the idea that tinnitus arises not in the ear, but in the parts of the brain that process sound. The trigger is an absence of input from the cochlea or parts of the cochlea. Essentially, your brain makes up sound where no sound exists.

It's like phantom pain that people get when they have lost a limb. There is no nerve input from the limb because it's gone; nevertheless, the person experiences the limb hurting.

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The NEW ENGLAND JOURNAL of MEDICINE

Tinnitus is like this—it's phantom noise. It can be an excruciating and unpleasant sensation.

This type of change in the brain (like what happens with tinnitus) happens quickly. We learn this from a journal as unimpeachable as the *New England Journal of Medicine*, the gold standard in America for medical research. Describing the pathophysiology of tinnitus, a review article published in 2002 stated:

> Hearing loss leads to a reorganization of the pathways in the central [brain] auditory system. These changes may occur rapidly and lead to abnormal interactions between auditory and other central [brain] pathways.[2]

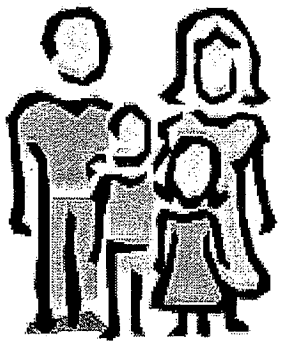
What's happening here is that the cells in the brain are making new connections, not good connections. It's like chaos in the brain, and the result is hearing a noise that isn't really there.

Wind Turbine Syndrome & tinnitus

Now listen to this story from *Wind Turbine Syndrome*.[3] A real Canadian family, family A in my study. We'll call them the Smiths. We'll call them Frank, Marlene, and their 2½ year old boy, Justin.

Frank, age 32, is a healthy fisherman who owns his own boat. Turbines, 10 in a row pointing at the house, the closest 1 km away, go online. For the first three weeks, Frank has repetitive popping in his ears, like pressure changes. After three weeks, a continuous headache starts whenever he's at home. It resolves after several hours every time he leaves the house, and comes back within several hours of coming home. Several weeks after the headache started, tinnitus starts and worsens over the duration of the 5-month exposure, until the family abandoned their home and rented a house in town.

Marlene, his wife, a 33-year-old accountant, likewise noticed repetitive popping in her ears for the first three weeks. She also noticed she couldn't hear as well as before. After three weeks, the tinnitus began. The tinnitus continued and worsened over time during the 5 months of exposure, varying according to how much she was at home and how loud the turbines were. After the exposure ended, she told me, the tinnitus resolved, but she noticed a new difficulty understanding conversation in a noisy room. She noticed she had to watch the speaker's face more closely.



During exposure, young Justin, a healthy 2½-year-old, pulled on his ears and got cranky at the same times that adults in the family noticed more headache and tinnitus. His language development was good before, during, and after exposure, but his mother noticed during exposure that the child began to confuse T with K sounds and W with L sounds, which he had not done before. This sound confusion was ongoing six weeks after exposure ended, when I interviewed the parents.

Let's match the research to the clinical account—match medical science to this real family. These two adults experienced pressure changes in their ears for some weeks, one with some loss of hearing. They then developed tinnitus. The tinnitus resolved when the noise exposure ended, but Marlene still noticed subtle differences in her own auditory processing and in her child's, Justin's.

Picking out one voice against background noise is an example of brain (or central) auditory processing, which means how your brain takes signals coming from your ears and puts them together into language, music, the song of a hermit thrush, or other recognizable and meaningful sounds.

To pick out one sound from background noise, your brain processes simultaneous signals from both ears, integrating the signals into a new type of perception that transcends what either ear can do alone. (It's sort of like depth perception with two eyes.)

Hearing in background noise is one aspect of brain auditory processing, and one that audiologists often test. Distinguishing language sounds is another critical part of how the brain processes sound, especially for children learning language.

So, what do we have? We have the *New England Journal* telling us that auditory pathways in the brain reorganize rapidly when there are deficits in the input from the ears, producing tinnitus. (Let's not ignore that this "reorganization" represents deterioration in function—not an improvement. Contrast this to the process of brain organization that occurs as a child learns language.) We have this research on the one hand, and on the other, younger healthy adults telling us their observations of their own hearing and hearing-related processes as they passed through a substantial bout of noise exposure.

Marlene described the noise, by the way, as, "Not noisy like a chainsaw; more like pulsating annoyance. To another person it wouldn't sound loud."

I suspect that in a child as young as Justin, 2½, who was removed from exposure so quickly, this process is entirely reversible. But such effects are less likely to be reversible with older age or longer exposure. That's a basic principle of how brains develop.

Noise exposure, even at relatively low sound levels, fouls up the parts of the brain responsible for figuring out language sounds, and the parts responsible for understanding and learning and remembering things we hear or read

I'm basing this interpretation of the Smith's experience on the tinnitus research and also on another area of research—on the effects of other types of environmental noise (like airport or traffic noise) on children's learning.

Learning to read is a language-intensive process that is especially sensitive to the effects of noise in school or at home. This effect is distinct from the effects of noise on attention or working memory,[4] and is correlated with measures of sound processing such as speech recognition.[5]

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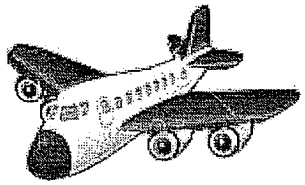


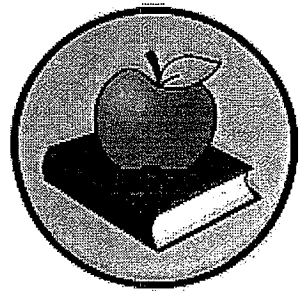
In one study, for example, a German city closed an old airport and built a new one. Researchers had the opportunity to follow the reading skills of both sets of children over time. Those living near the airport that closed showed improvement in their reading. The ones near the new airport slowed down in their learning after the airport opened.[6]



Another study looked at the effects of noise on both reading and auditory processing in children who lived in an apartment building next to a busy highway. Auditory processing, again, is what your brain does with the signals from your ears to turn them into meaningful language or other sounds.

The higher the children lived in the building, the quieter were their apartments and the better their reading and auditory discrimination scores, which means, for example, distinguishing the word *goat* from *boat.* The study factored out the effects of parent education and income, and then found that children exposed to more noise were more delayed in their reading. The amount of delay in reading was explained by how badly the children were doing distinguishing language sounds from each other, which also worsened with more noise.[7]

In other words, the presence of noise in the environment degraded how these children's brains processed language sounds, which in turn degraded their ability to learn to read. It wasn't that the noise just kept them from hearing things they needed to learn; the noise actually harmed their brain's ability to process language, even when that language was coming in through their eyes, as it does when we read.



Moreover, these effects of noise on reading occur at sound levels far less than those needed to produce hearing damage.[8] Children at higher grade levels are more affected, and longer exposure produces larger deficits, other studies have shown.[9]

In my wind turbine study, 7 out of the 10 school-age children and teens did worse in school during exposure to turbines, compared to before or after, including unexpected problems in reading, math, concentration, and test performance, noticed by both teachers and parents. Teachers sent notes home asking what was wrong with the children.

Subtle as these effects are, they have serious implications. Noise exposure,

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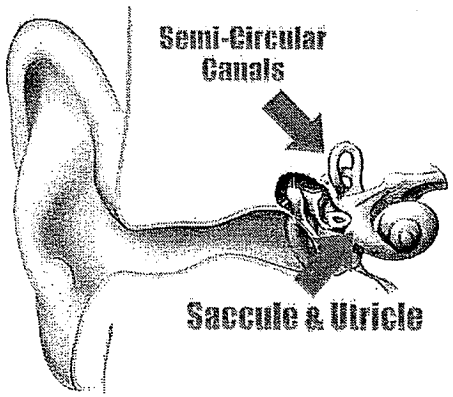
even at relatively low sound levels, fouls up the parts of the brain responsible for figuring out language sounds (what we call language processing) and the parts responsible for understanding and learning and remembering things we hear or read (what we call language-based learning).

Let me emphasize: Noise exposure, even at low levels that don't damage hearing, can do this.

The Balance Organs: A protean presence in the brain, in terms of what types of sensations they draw on and how the information is used by the brain



There is another set of organs in the inner ear, the organs of balance (called the vestibular organs), consisting of the utricle and saccule (the two otolith or "ear rock" organs, where microscopic stones control our perception of gravity and movement in a straight line) and the semicircular canals, which detect rotations of the head in three planes.

The balance system is probably the least well known of all the senses for both the general public and physicians. It's a different kind of sense. It has some dedicated organs (the vestibular organs in the inner ear, just described), but these organs do not function on their own, not without the cooperation (and brain integration) of multiple sensory signals from all over the body.

We use this sense not just for balance (staying upright), but also for telling where we are in space and how fast and in what direction the different parts of our bodies are moving, at all times.

The vestibular sense feeds back instantaneously, for example, on the eye movement muscles and on posture-maintaining muscles in the neck and back. It also adapts to gravity by controlling tension in the arteries and smaller blood vessels all over the body, and how hard the heart is pumping, to keep the blood evenly distributed whether you are standing up, lying down, or standing on your head.

Balance and motion detection requires input from the eyes, from stretch receptors in the muscles and joints all over the body, from touch receptors in the skin, and, it is now known, from stretch and pressure receptors in and around internal organs and the great blood vessels in the chest and abdomen.[10] As well as requiring signals from the inner ear—the utricle, saccule, and semicircular canals.

This is a remarkable feat of brain integration, especially when the signals don't all agree with one another. The brain has to figure out which signals to downweight or ignore if they don't all agree, or if the signals from one chan-

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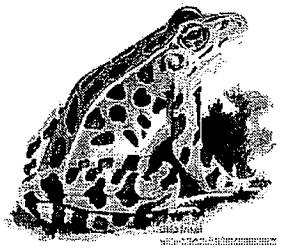
nel are distorted.

Even fish have otolith organs and semicircular canals. The cochlea, or specialized hearing organ, evolved later, our type specifically in mammals. The brain essentially grew up, through evolution, with vestibular neurons and signals already in place. As a consequence, our systems for detecting movement, gravity, pressure, and vibration have a protean presence in the brain, going everywhere, both in terms of what types of sensations they draw on, and how the information is used by the brain.



In fish and amphibians, the otolith organs are much better detectors of low-frequency noise and vibration than are these animals' own versions of sound-detecting organs.[11,12] We now know that even in mice—a mammal—low-frequency, air-borne sound is detected by the otolith organs.[13] In humans, detection of low frequency sound by the otolith organs has been shown only using bone-conducted sound, meaning a source of vibration placed right against the head.

At 100 Hz, the tone of a moderately low note on the piano, healthy adults can detect a bone-conducted vibration at 15 dB below their own normal hearing thresholds, probably through the utricle.[14,15] "Detection" in this case means that the vibration triggers an automatic reflex in muscles around the eyes or in the neck, a response that can only be due, we know, to vestibular stimulation.

All this by way of saying that we are getting nearer to understanding the pathophysiological mechanisms causing Wind Turbine Syndrome.

Wind Turbine Syndrome resembles inner ear pathology witnessed by otolaryngologists

The symptoms of Wind Turbine Syndrome directly mirror the symptom clusters that practicing otolaryngologists have seen for years in patients with balance problems due to vestibular inner ear pathology.[16,17] With vestibular pathology, however, the symptoms are not known to come and go with noise exposure. Very importantly, the symptoms associated with vestibular pathology are not just about balance or dizziness, as I'll review in a moment. Indeed, the symptoms clinically reveal the linkages between the balance-processing parts of the brain, and cognition and memory—linkages only now being described through experiments and functional brain imaging.

Over 90% of my sample of affected people, both adults and children, had cognitive difficulties during wind turbine exposure—problems that lingered and resolved slowly after exposure ended. These included difficulties with reading, math, spelling, writing, multitasking in kitchen and home, remembering a series of errands, maintaining a train of thought in a telephone conversation, following the plot of a TV show, following recipes, and following directions to put together furniture.

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Balance-disordered patients in clinical practice also struggle with short-term memory, concentration, multitasking, arithmetic, and reading. Patients with inner ear fluid leakages, for example, present with symptoms of dizziness, headache, stiff neck, and disturbed sleep, accompanied by marked mental performance deficits compared to baseline.[18]

This kind of inner ear leakage can be set off by whiplash injuries, mild head trauma, or pressure trauma to the ear. The fluid leak is associated with an imbalance of fluid pressures in the inner ear, known as endolymphatic hydrops, which distorts both balance and hearing. (Ménière's disease, in which balance and hearing disturbances fluctuate, is endolymphatic hydrops that comes and goes for unknown reasons.)

Tellingly, Dr. Alec Salt, who will speak next on infrasound effects on the inner ear, has discovered experimentally that infrasound exposure causes temporary endolymphatic hydrops.[19] This is a possible mechanism for the balance disturbances, tinnitus, headache, and cognitive problems of Wind Turbine Syndrome.

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The balance system is closely linked to emotions, especially fear, anxiety, and panic

So far, I have talked about how the absence or distortion of *hearing signals* from the inner ear affects thinking and learning at the brain level, and how distortion of *balance signals* from the inner ear affects thinking, memory, and concentration at the brain level. There is one more subject in this cluster of sensory/brain-function linkages, which I would like to discuss.



The balance system is closely linked to emotions, especially fear, anxiety, and panic. When my foot slides on ice under some new snow and I fling my arms out to regain balance, I have a moment of panic. My husband has fear of heights for reasons directly attributable to his brain's style of balance signal integration. I don't, and love to sit on the edge of cliffs over the ocean, watching seabirds.

When he sees me doing this, or if he gets near the edge himself or goes to the top of a tall building, he feels dizzy and nauseated (which are direct balance problem symptoms) and also panicked and irrational—afraid that he or I might fall or even jump off.

(I didn't have a full sense of this until recently, he's so controlled and calm, but now I understand why he doesn't want to take me back to Newfoundland—where there are huge, wonderful seabird cliffs...)

In some studies of balance-anxiety linkages, up to 80% of people with panic disorder have measurable disorders of balance processing. The places where people panic are those in which they "lose their bearings," so to speak, due to distortion of balance signals and their own brains' particular style of dealing with distorted balance signals. Grocery stores have been always a big culprit.

In my wind turbine study, 2/3 of the adult subjects (14 out of 21) experienced a highly disturbing collection of symptoms when exposed to high levels of turbine noise. They felt movement inside their chests, described as quivering, jitteriness, or pulsation, and then an uncomfortable urge to flee—to get out of there. Or, if the feeling awoke them at night, panic, with racing heart, a feeling they could not breathe, or the sense that there just had been an alarming noise—like a window breaking—and that they had to get up to check the house.

Wind Turbine Syndrome panic symptoms linked to previous history of motion sensitivity

None of these people had had panic attacks in their lives before. Several had histories of anxiety or depression, but altogether, among all the adults in the study, a previous mental health problem was not significantly associated with the presence of this panic symptom. What was associated with the panic symptom, with a highly significant statistical relationship, was a previous history of motion sensitivity.



Even a tough cowboy from Missouri, a welder who raises horses, had this symptom awakening him at night near turbines. Once he and his family moved into town, he slept like a baby. No more panic awakening. (It was his wife who had to tell me about it, however.) Even the physician in my study had this symptom. Toddlers and preschool children in my study had a similar symptom—awakening in the night in states of high alarm and unable to go back to bed or to sleep.

In short, noise impinging on the ear is not just about hearing, we are learning, but also about how the brain organizes itself around sound.

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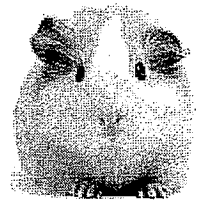
Summary

- Wind turbine noise causes tinnitus in many exposed people. Tinnitus at the physiologic level is the result of a change in sound processing by the brain.
- Other types of environmental noise have been shown to impair children's learning by changing how they process language sounds. Families exposed to wind turbines noticed deterioration in their children's thinking and learning abilities during exposure. Adults also had problems with thinking, memory, and concentration during exposure.
- Other clinical and brain studies have shown that diminished thinking and performance are tied to malfunctioning of the vestibular portion of the inner ear.
- Distorted balance signaling has a close connection with panic and anxiety in a variety of situations, a linkage that may explain how panic in the night crops up in previously non-panicked but motion-sensitive people exposed to wind turbines.



Alec Salt, PhD, demolishes A-weighting noise measurements, while demonstrating that the ear has a physiological response to low frequency noise at the intensities produced by wind turbines

Professor Alec Salt is a cochlear physiologist, a laboratory scientist in the Department of Otolaryngology at the Washington University School of Medicine in St. Louis. He and his students study the fluids and physiology of the cochlea (the hearing part of the inner ear) in guinea pigs.

For years, Salt and his colleagues have used infrasound to change the way parts of the cochlea behave—not because they were interested in infrasound, but because it has physiologic effects which are useful in their studies of cochlear fluids and cells.

In the last year or so, Dr. Salt documented that the two types of sensory cells in the cochlea, the inner and outer hair cells, react differently to infrasound. The inner hair cells, which are the ones that send hearing signals to the brain, do not respond to infrasound, but the outer hair cells do.

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Infrasound, he discovered, makes the outer hair cells move in such a way that they prevent the inner hair cells from responding. The outer hair cells also send neural signals to the brain and to other outer hair cells, but it is not clear what these signals do once they reach the brain. One thing we do know is that they don't convey sound stimuli, themselves. Some evidence suggests they may play a role in mediating the perception of loud sounds in the cochlear nucleus, the first relay point for sound impulses in the brain.[20,21]

What's significant for Wind Turbine Syndrome is Dr. Salt's discovery that the cochlea does indeed respond to infrasound, and sends signals to the brain in response to infrasound, but the anatomy and cellular responses of the outer hair cells actively prevent us from hearing the infrasound.

Wondering whether these findings had any significance to people and their diseases, Dr. Salt searched the medical literature last winter and came across Wind Turbine Syndrome. He subsequently published a research article linking his findings to the symptoms or clinical manifestations of Wind Turbine Syndrome.[22]



It's worth emphasizing that Professor Salt is an outstanding educator, as is clear from his website. There is a lot to be learned here about the inner ear, complete with moving, colored, 3-D simulations.

His recent research article is posted here, with a user-friendly discussion of its significance. There is also a link to the website of the National Institutes of Health, where his research is featured. He has also posted the slides from his presentation at the Picton conference on October 30.

In his presentation, Dr. Salt compared measured wind turbine sound spectra, not only to the human hearing response curve (as the wind industry consultants do), but also to the separate response curves of the inner and outer hair cells, showing that wind turbine low-frequency noise and infrasound are easily detectable by the normal cochlea. He also demonstrates how A-weighted sound level measurements specifically exclude the low frequencies significant in wind turbine health effects, effectively demolishing the credibility of A-weighted noise measurements.

Dr. Salt's research is exciting and useful because it pointedly disproves the wind industry's assertion that the infrasound produced by wind turbines is not relevant to human health because it is, they claim, below the hearing threshold of most people. On the contrary, the ear has a physiological response to low frequency noise at the intensities produced by wind turbines, even when this noise cannot be heard.

A physiologic response opens the door, of course, to clinical effects.

With regard to the mechanism of Wind Turbine Syndrome, we are now in the interesting position of having, on the one hand, a demonstrated cochlear response to infrasound without a known brain response. On the other hand, if we consider the vestibular (balance) organs in the inner ear (which share physiology and fluid connections with the cochlea), we know a lot about brain responses. There is a large scientific literature on what the brain does

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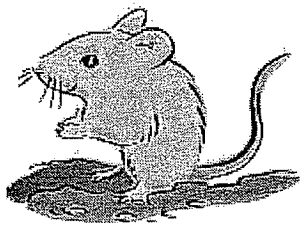
with normal or distorted vestibular signals with regard to sensations, symptoms, brain cell pathways, and functional and experimental problems.[23]

We also know that the symptom complex of Wind Turbine Syndrome is very similar to the symptoms of vestibular dysfunction.

What is lacking is direct evidence for air-borne infrasound stimulating the hair cells of the vestibular organs. Dr. Salt told us in his conference talk that the vestibular hair cells are "tuned" (meaning, have their best response) to body-borne vibrations at infrasonic frequencies, but that no one has yet looked at the responses of these cells to "acoustic" (meaning, air-borne) infrasound coming in through the outer and middle ear.



"Jumping mice": Mammalian balance organs detect air-borne low-frequency sound using their otolith organs (saccule & utricle)

I suspect it's only a matter of time—and short time, at that—before some research group shows air-borne infrasound stimulating the vestibular hair cells, or shows a human vestibular response to air-borne infrasound. I base my prediction in part on a new article Dr. Salt sent to me immediately after the conference, titled, "The vestibular system mediates sensation of low-frequency sounds in mice."[24] In it, the authors explain how the "ancestral acoustic sensitivity" of the saccule has been retained not only in fish and amphibians, but also, according to recent evidence, in birds and mammals.

The authors demonstrate how mouse otolith organs respond to air-borne, low-frequency sounds below the detection range of the mouse cochlea.

Mice jump when startled by a beep. They startle more, with a more vigorous jump, in the presence of a low- or mid-frequency background sound. The authors measured this "startle response"—how much the mice jumped—quantitatively on little electronic platforms. Genetically normal mice jump more in response to either low- or mid-frequency background sound, but the authors also tested mice which, for genetic reasons, never developed the otoconia (little stones) in their otolith organs (utricle & saccule). Significantly, these otolith-deficient mice did the extra-large jumps only when the background sound stimulus fell within the frequency range of the mouse cochlea. They didn't detect the low-frequency background sound stimuli the way the mice with functioning otolith organs did.

Jumping mice. The authors of this study have demonstrated that mammalian ears, using their otolith organs of balance and motion detection, detect air-borne low-frequency sound at frequencies too low to be heard by their cochleas. This makes them startle more. Now consider "jumping people"—startled right out of bed in the middle of the night in the presence of subaudible, low-frequency noise, or infrasound, from wind turbines.

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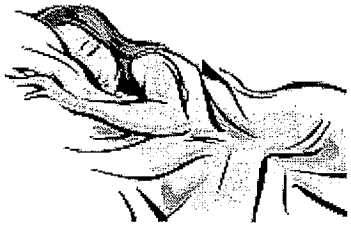
Evidence like this suggests the following mechanism for Wind Turbine Syndrome: air-borne or body-borne low-frequency sound directly stimulates the inner ear, with physiologic responses of both cochlea and otolith organs.

Physiologic responses in the cochlea suppress the hearing response to low-frequency sound but still send some signals to the brain, signals whose function is, at present, mostly unknown. The physiologic response of the cochlea to turbine noise is also a trigger for tinnitus and the brain-cell-level reorganization that tinnitus represents—reorganization that can have an impact on language processing and the learning processes related to language processing. Physiologic responses and signals from the otolith organs tie into a wide range of known brain responses to vestibular signals, including dizziness and nausea (seasickness without the movement), fear and alerting (startle, wakefulness), and difficulties with visually-based problem-solving.



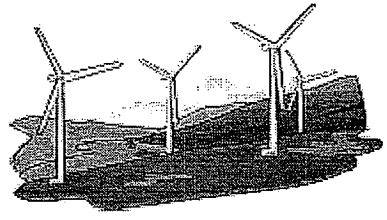
Christopher Hanning, MD, and sleep arousal

The interaction between sleep and these ear-brain mechanisms is interesting. Wind turbines create a particularly disturbing kind of noise with high alert potential, Dr. Chris Hanning, a sleep specialist, explained at the conference.

Our sleep is disturbed not only when we wake up completely, but also by subclinical arousals—in which the body and brain move into a lighter phase of sleep without waking all the way up. This type of disturbance requires even less noise than full awakening, but still disrupts sleep and its restorative properties for mood, memory, thinking, alertness, and coordination.

People vary in how deeply they sleep, and how resistant they are to awakening or arousal by noise. We can reliably measure how much people are disturbed during sleep using questionnaires about their daytime functioning.

Rick James, Noise Control Engineer: Sick Building Syndrome



Turning to noise studies around wind turbines, noise control engineer Rick James presented sound monitoring data showing the disturbing, high-alert qualities of wind turbine noise: high levels of low frequency noise and infrasound, and the pulsating quality of the low frequency noise and infrasound. Both the audible noise and the infrasound from turbines are subject to "amplitude modulation" (meaning, the loudness goes up and down)—a quality that adds markedly to its disturbing character.

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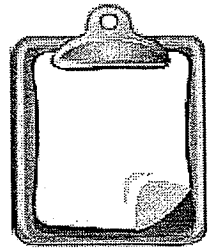
The arrangement and spacing of turbines in clusters also affects how much noise they make, because a second turbine, beating in the downwind turbulence of the first turbine, makes more noise.

Mr. James reviewed research from the 1980's and '90's on illness in office workers, induced by low-frequency noise from mal-aligned fans or vibrating ducts in the heating, ventilation, and air conditioning systems of large buildings. Research on these specialized cases of "Sick Building Syndrome" focused on the detrimental effects of low frequency noise on work productivity, and included experimental assessment of low frequency noise effects on concentration and mood.[25]

A word of caution, however. The term "Sick Building Syndrome" is associated most commonly with problems of indoor air quality (including particulates, allergens, infectious particles, solvent odor, and the amount of fresh air), and the syndrome includes irritation of the skin, eyes, and respiratory tract, as well as fatigue, headache, poor concentration, nausea, and dizziness.[26] The latter symptoms are commonly associated with low frequency noise exposure in other contexts, whereas skin and mucous membrane irritation are not.

In other words, although Wind Turbine Syndrome shares the noise-related aspects of Sick Building Syndrome, the two terms are not the same.



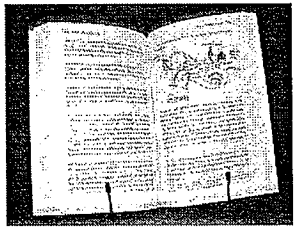
Michael Nissenbaum, MD, reports that surveyed subjects up to 3 miles from turbines showed effects on sleep and mood that varied directly with distance from the turbines

Finally, Dr. Michael Nissenbaum, a Maine physician, presented results of a study of 79 adults living up to three miles from wind turbines in Maine, who completed (what are clinically called) validated questionnaires on sleep disturbance and general physical and mental well-being, divided into study and control groups based on distance from turbines.

Dr. Nissenbaum found differences between the study and control groups in several sleep quality indices, and in the mental health component of the general questionnaire. Even more remarkable, when he pooled the data from study and control groups, he found a dose-response relationship out to about 5 km (3 miles) from turbines. Subjects up to 3 miles from turbines, whether they were initially considered to be in the study or control groups, showed effects on sleep and mood that varied directly with distance from the turbines, Dr. Nissenbaum reported.

This is a valuable study. The surveys required information only about the sub-

jects' current state of sleep and well-being, without reference to the turbines. The impact of turbine noise is apparently seen much farther away than the 1.5-2 km minimum setback proposed by many researchers (including me), although there was a drop-off in symptoms beyond 1.4 km. The questionnaires did not sample the full range of Wind Turbine Syndrome symptoms, but provide a standardized and quantified measure of one important symptom—sleep disturbance—and of general medical and mental health in relation to turbines.

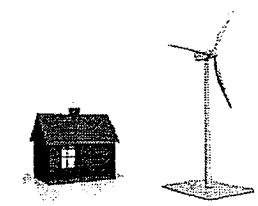


The "Humanness" of Wind Turbine Syndrome

Such is the state of Wind Turbine Syndrome research a year after I published "Wind Turbine Syndrome: A Report on a Natural Experiment." As I said earlier, we have made substantial progress in figuring out the mechanism and other parameters of this industrial plague.

It's worth pointing out that, with one notable exception, none of this was done with government or industry or foundation support —either financial or moral support. Just the opposite, governments (at all levels) and the wind energy industry have actively tried to thwart this research. But—this pleases me immensely—it was accomplished despite their opposition.

The exception being the National Institutes of Health, which funded Dr. Salt's research. All praise to the NIH!



A final word. For me, it was both sobering and energizing to talk, again, with victims of Wind Turbine Syndrome at the conference. At times, distracted by political and journalistic "noise," I forget how serious WTS actually is.

Separately, a man and a woman from different countries told me quietly of their thoughts of committing suicide. Both are older with good marriages and productive lives and adequate resources. One has been driven from her home by relentless nausea and vomiting, and the other is made ill whenever he returns home.

While governments, the wind industry and its scientific and clinical hirelings, and the media continue to belittle and deny the experience of these individuals—Lord knows, the media is filled with denial, ridicule, and venom (Google "Wind Turbine Syndrome")—I am reminded, once more, that the physical, mental, social, and financial consequences of this perfectly correctible condition are appalling.

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References

1. Kandel ER. 2000. The molecular biology of memory storage: a dialog between genes and synapses. Nobel Lecture. Click here.

2. Lockwood AH, Salvi RJ, Burkard RF. 2002. Tinnitus. N Engl J Med. 347(12): 904-10.

3. Pierpont, N. Wind Turbine Syndrome: A Report on a Natural Experiment. K-Selected Books, 2009, 294 pp.

4. Haines MM, Stansfeld SA, Job RFS, Berglund B, Head J. 2001. A follow-up study of effects of chronic aircraft noise exposure on child stress responses and cognition. Int J Epidemiol 30: 839-45.

5. Evans GW, Maxwell L. 1997. Chronic noise exposure and reading deficits: the mediating effects of language acquisition. Environ Behav 29(5): 638-56.

6. Hygge S, Evans GW, Bullinger M. 2002. A prospective study of some effects of aircraft noise on cognitive performance in schoolchildren. Psychol Sci 13: 469-74.

7. Cohen S, Glass DC, Singer JE. 1973. Apartment noise, auditory discrimination, and reading ability in children. J Exp Soc Psychol 9: 407-22.

8. Evans GW. 2006. Child development and the physical environment. Annu Rev Psychol 57: 423-51.

9. Evans 2006.

10. Mittelstaedt H. 1996. Somatic graviception. Biol Psychol 42(1-2): 53-74.

11. Fay RR, Simmons AM. 1999. The sense of hearing and fishes and amphibians. In Comparative Hearing: Fish and Amphibians, ed. Fay RR, Popper AN, pp. 269-317. Springer-Verlag, New York.

12. Sand O, Karlsen HE. 1986. Detection of infrasound by the Atlantic cod. J Exp Biol 125: 197-204.

13. Jones GP, Lukashkina VA, Russell IJ, Lukashkin AN. 2010. The vestibular system mediates sensation of low-frequency sounds in mice. J Assoc Res Otolaryngol 2010 Sep 4. [Epub ahead of print].

14. Todd NPMc, Rosengren SM, Colebatch JG. 2008. Tuning and sensitivity of the human vestibular system to low-frequency vibration. Neuroscience Letters 444: 36-41.

15. Todd NP, Rosengren SM, Colebatch JG. 2009. A utricular origin of frequency tuning to low-frequency vibration in the human vestibular system? Neurosci Lett 451(3): 175-180.

16. Grimm RJ, Hemenway WG, Lebray PR, Black FO. 1989. The perilymph fistula syndrome defined in mild head trauma. Acta Otolaryngol Suppl 464: 1-40.

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17. Hanes DA, McCollum G. 2006. Cognitive-vestibular interactions: a review of patient difficulties and possible mechanisms. J Vestib Res 16(3): 75-91.

18. Grimm et al. 1989.

19. Salt AN. 2004. Acute endolymphatic hydrops generated by exposure of the ear to nontraumatic low-frequency tones. J Assoc Res Otolaryngol 5(2): 203-14.

20. Benson TE, Brown MC. 2004. Postsynaptic targets of Type II auditory nerve fibers in the cochlear nucleus. J Assoc Res Otolaryngol 5(2): 111–125.

21. Weisz C, Glowatzki E, Fuchs P. 2009. The postsynaptic function of Type II cochlear afferents. Nature 461(7267): 1126–1129.

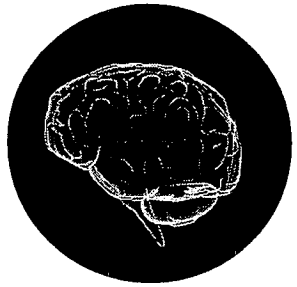
22. Salt AN, Hullar TE. 2010. Responses of the ear to low frequency sounds, infrasound and wind turbines. Hear Res 268(1-2):12-21.

23. This field is reviewed in Wind Turbine Syndrome, pp. 72-99, 195-205, and 226-244.

24. Jones et al. 2010.

25. Persson Waye K, Rylander Right, Benton S, Leventhall HG. 1997. Effects on performance and work quality due to low frequency ventilation noise. J Sound Vibr 205(4): 467-474.

26. World Health Organization. 1982. Indoor air pollutants: exposure and health effects. Pp. 23-25.



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APR 01 2011
UMATILLA COUNTY
PLANNING DEPARTMENT

To Umatilla County Board of Commissioner:

Dear Sir:

I would like it let you know that I am strongly in favor of the proposed two-mile set backs for the siting of wind facilities in Umatilla County.

Thank you

Signed

Karen Engels

Karen K. Engels
PO Box 529
Milton Freewater OR 97862

00003378

March 30, 2011

RECEIVED

APR 05 2011

UMATILLA COUNTY
PLANNING DEPARTMENT

Umatilla County Board of Commissioners
Umatilla County Courthouse
216 SE Fourth Street
Pendleton, OR 97801

Re: Addendum to previous submitted March 20,2011 for the forthcoming BOC meeting and subsequent Open Record period

Honorable County Board of Commissioners:

Setback requirements are pivotal in the decision process of future windmill development for all citizens of Umatilla County. They impact affected landowners greatly. In the past, setback requirements have been determined as a guess or estimate at best. This has placed affected landowners at a significant disadvantage in the decision making process. As a result, it has impacted these landowner's quality of life and property values. We must have a factual way to establish setback requirements; a way that will reduce the hardships and financial losses to those landowners. That requires Setback Requirements to be established on fact and credible information and data. The objective of Setback Requirements is to mitigate the impacts to the affected landowners and make them part of the process. This will reduce their exposure to adverse impacts resulting from the proposed wind projects and will provide future opportunities for better project overviews.

At the Board of Commissioner's meeting on March 17, 2011 Mr. Reeder and the Planning Commission Committee presented a proposed document UCDC#T-10-039 . A vital part of that proposal dealt with recommended **Setback Requirements**. We support the Commission's Proposal as presented.

Mr. Reeder submitted data generated by the Windmill Company and their Engineering Contractor, CH2M Hill for the proposed Helix Wind Project. Mr. Reeder's analysis was based on their data and maps displaying the projected analysis for this specific project at two proposed generating alternatives – 1.5mw and 3.0mw respectively. Mr. Reeder's analysis is the most credible and applicable data on which to establish **Setback Requirements**. We support this process and analysis and its' use in making your decision on **Setback Requirements.**

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It should be pointed out that Mr. Reeder took his measurements from proposed tower sites to establish distance to the 36dBA threshold line. However, to meet **Oregon DEQ Noise Setback Requirements**, distances must be such as to be **less than 36dBA** as that is the threshold point. Therefore, Mr. Reeder's calculations as to required setbacks are to be considered minimal and in actuality, would not resolve mitigation issues. i.e., Mr. Reeder's resulting setback distances **must be increased to meet DEQ requirements.** This is a straight forward fix in Mr. Reeder's analysis but, one that must be done to establish the setback issue to meet DEQ's requirements.

Mr. Reeder's analysis of the Helix Wind Project data brings to light another issue - **Cumulative Effects.** The Helix Project is adjacent to and in close proximity to previously constructed and operating windmill projects. The adjacent landowners are impacted already and proposed projects only tend to add to those impacts. Therefore, pre-project data such as the Credible Noise Study should be required for future projects, where this appears to be an issue. The pre-project data would be valuable as a project planning tool that would help in being **Proactive rather than Reactive** to these issues.

As Wind Development progresses within the Umatilla County, proposed projects are encroaching into areas where Landowner conflicts and **Cumulative Effects** become an important issue. Previous projects in conjunction with proposed projects intensify impacts and conflicts.

Setbacks are becoming more and more critical as more projects enter the process for consideration. Setbacks must be factual based – **not unsupported estimates.** To follow that method will place affected Landowners and Windmill Companies at odds with each other in trying to mitigate the issues. That could be avoided with more comprehensive project planning. That situation places the Windmill Companies with large resources against Affected Landowners with limited resources in a very untenable situation. This does not need to happen and can be minimized with carefully selected planning tools and **the Setback Requirement decision is based on factual, credible and supportable information.**

The Helix Wind Project application and subsequent amendment serves to demonstrate what can happen if setbacks are based on guesswork, estimates and pure emotion. The project is well along in the approval process and

with no factual guidance on which to base setbacks, the wind company and the affected landowners, of which there appear to be as many as forty residences that are within the 36dBA parameters, are faced with a huge dilemma. The process guidelines, or lack thereof, have literally thrown them to the wolves. The landowners with limited resources are forced to defend their property rights against a system that has basically unlimited resources. All, if not most of this unfair, unnecessary burden on these landowners could have been avoided if adequate setback standards and guidelines were in place at the beginning of the process, rather than by default at the conclusion of the project. We now have an opportunity to correct this unfair and unacceptable mistake by simply applying facts, data and professional engineering science to avoid these costly mistakes to the landowner in the future. We support the BOC doing exactly that; adopt Mr. Reeder's analysis and the Planning Proposal as presented.

The Umatilla County Commissioners now have valuable information, thanks to Mr. Reeder's analysis and the Planning Commission Committee's hard work over the last few years. We strongly recommend you use this asset to make your decision on this very important matter for all the citizenry of Umatilla County.

Respectfully submitted,

Dave and Judy Price
80488 Zerba Road
Athena, OR 97813

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MAR 3 0 2011

UMATILLA COUNTY
PLANNING DEPARTMENT

242 NE 13th Ave.
Milton Freewater, OR
97862

Umatilla Co. Board of Comm.
216 SE Fourth St
Pendelton, OR 97801

To the Board,

I am writing to urge the Board to vote in may on the setback for wind facilities.

I agree the proposal of a two mile setback on wind facilities would be a wise move.

We can't even yet know much these facilities will effect every one. Thank you for reconsidering the move.

Sincerely,

(Lillian Duncan) Lillian Duncan

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MAR 2 9 2011

UMATILLA COUNTY
PLANNING DEPARTMENT

To the Umatilla County Board of Commissioners,

Sirs,

I am writing in regards to the March 17th BOC meeting which I attended. I wish to commend the Umatilla County Planning Commission and Commissioner Reeder for a very well thought out plan dealing with the siting of wind turbines in Umatilla county. It appears to me that this plan is a fair, unbiased approach to dealing with the problems of siting heavy, industrial turbines in rural land zoned EFU.

The set back issue seemed to be the hot button topic and it was also the reason I attended the meeting. While I would prefer a larger set back distance, I would support a middle ground figure of the 2 miles that the planning commission unanimously approved.

After listening to Mr. Jeff Newtson's testimony I was a little confused when he testified that he lived under the turbines. He stated that neither he nor his family suffered any ill effects. I am including a county map with his former and current residence hi-lighted. After checking this county map I realized that he had testified for just the set back distances that I would settle for. His former home sits slightly over 2 miles from the nearest turbine (his home did sit down a hill from the turbines). His current residence is over 3 miles from the nearest turbine. These are the small turbines.

In closing I would urge you to adopt the planning commissions revisions to county standards for wind development in Umatilla county.
Thank you for your hard work on our behalf and this chance to express my opinion.

Sincerely,
Robin Severe
82422 Vansycle Rd
Helix, Oregon 97835
Severe@wildblue.net

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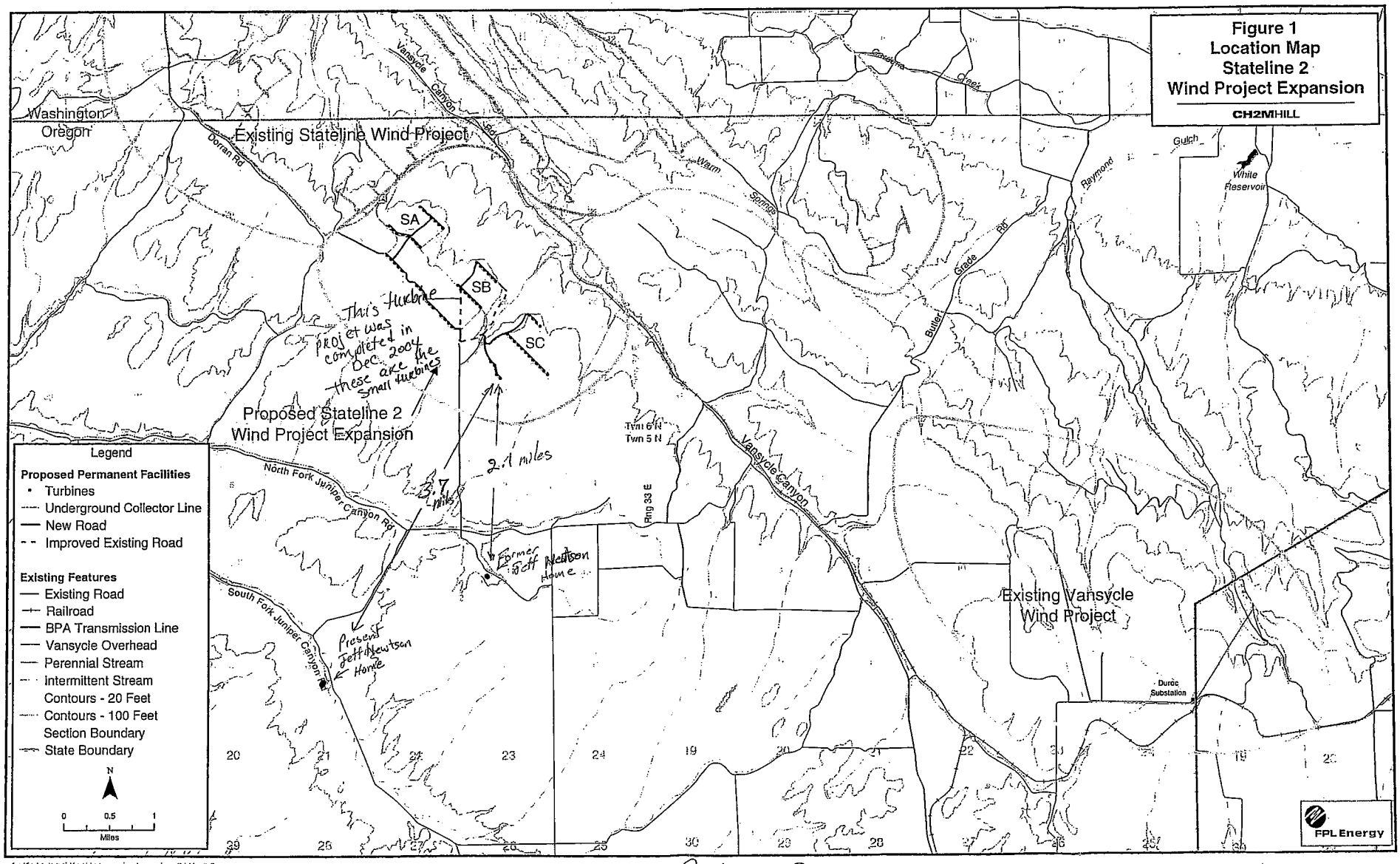

Submitted by Robin Severe 3-29-11

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MAR 2 9 2011

UMATILLA COUNTY
PLANNING DEPARTMENT

Jay and Julia Spratling
81671 Kupers Road
P.O. Box 309
Helix, Oregon 97835

To be Submitted
To Umatilla Co. Comm.

Mr. John G. White
Oregon Department of Energy
625 Marion St. NE
Salem, Oregon 97301-3742

March 28, 2011

Mr. White,

We farm and reside in Vansycle Canyon, north of Helix, Oregon. I am writing in reference to the Helix Wind Farm project currently in the process of being permitted in our neighborhood by Iberdrola Renewables. The location of our residence is R16 on the map submitted by Iberdrola Renewables. We currently have wind farms to the north of our home and another wind farm to the east of our home, neither of which is shown on the aforementioned map. If the proposed wind farm is allowed to go in, we will be completely surrounded by wind turbines. How much encroachment are individual residents to be subjected to by entities who do not live in this area? We believe that these wind farms are detrimental to our health, our property values and our very way of life. We also know that they are a poor use of taxpayer dollars. The facts are simple: 1. Wind farms do not supply adequate "firm" electricity. They are considered an "intermittent" energy source. 2. The cost of wind farms is only sustainable by taxpayer subsidies. 3. Wind farms and their noise are detrimental to those living within their boundaries. 4. Wind farms detrimental to property values. 5. Wind towers are unsightly and a bane to the landscape. 6. Wind farms are unprofitable. The only one's profiting from them are those who choose to install wind towers on their property at the expense of every tax payer in this nation. Wind towers have no place on agricultural land. We farm here and can make an adequate living by working our land. Those farmers who state they are unable to profit from farming and thus must grow "wind towers" need to work harder at their craft. We have chosen to live in rural America because of a love for the land, and allowing more unsightly wind towers is damaging to our lifestyle. Why should "neighbors" be allowed to make changes to their property that adversely affects all those surrounding neighbors? We have found that few of our friends and neighbors in Vancycle Canyon are in favor of these wind turbines and the noise and nuisance they bring with them. It is interesting to me that those farmers wishing to build wind towers on their property don't live near the wind turbines. When they put one in their backyard, perhaps it will make their ideas more credible.

There are three residences on our gravel road. When the wind farm that is to the west of us was built, forty semi loads of materials drove by our house each day. The dust and the damage to the county road was unbelievable. The county road continues to be abused by the maintenance people who travel this road multiple times every day. The noise is constant. As soon as you drive over a nearby rise, you can hear the constant drone of the turbines. Chase Whitney of Iberdrola Renewables has contacted many of our neighbors about signing a noise easement to allow the DBA to go above the current DBA approval rate. While we have not been contacted personally by Mr. Chase, we have spoken to our neighbors

and know that none of them are interested in signing a noise easement. We will not be signing a noise easement. I wonder if the taxpayers would be interested in knowing the amount of money that is being offered to "buy" the silence of each neighbor to the wind farm. After all, it is the taxpayers money.

Another question I would be interested in receiving an answer to is why are we so interested in allowing entities of foreign countries to build in our area?

In conclusion, anyone with common sense and who have any interest in our country and its continuing energy needs, knows that wind power is not the answer. They are not self-sustaining. They cannot bring sustainable jobs without taxpayer subsidies. There is no credible information on how long they will last; if there was there would not be clauses added to contracts for their removal. They are detrimental to the health and well-being of everyone who lives within sight or sound of them. They are a mar on the landscape and they are an insult to the intelligence of rural Americans. Plain and simple, they are a "get cash quick scheme" for a few individuals at the expense of all those around them.

Please reconsider allowing the siting of yet another wind project in our area.

Respectfully submitted,

Jay Spratling
Julia Spratling

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UMATILLA COUNTY
PLANNING DEPARTMENT

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Jay and Julia Spratling
81671 Kupers Road
P.O. Box 309
Helix, Oregon 97835

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Umatilla County Commissioners
Umatilla County Courthouse
216 SE 4th
Pendleton, Oregon 97801

BILL HANSELL _____

LARRY GIVENS _____

DENNIS DOHERTY _____

March 28, 2011

Dear Sirs,

We farm and reside in Vansycle Canyon, north of Helix, Oregon. I am writing in reference to the Helix Wind Farm Amendment Project currently in the process of being permitted in our neighborhood for Iberdrola Renewables. The location of our residence is R16 on the map submitted by Iberdrola Renewables. We currently have wind farms to the north of our home and another wind farm to the east of our home, neither of which is shown on the aforementioned map. If the proposed wind farm is allowed to go in, we will be completely surrounded by wind turbines. How much encroachment are individual residents to be subjected to by entities who do not live in this area? We believe that these wind farms are detrimental to our health, our property values and our very way of life. We also know that they are a poor use of taxpayer dollars. The facts are simple: 1. Wind farms do not supply adequate "firm" electricity. They are considered an "intermittent" energy source. 2. The cost of wind farms is only sustainable by taxpayer subsidies. 3. Wind farms and their noise are detrimental to those living within their boundaries. 4. Wind farms are detrimental to property values. 5. Wind turbines are unsightly and a bane to the landscape. 6. Wind farms are unprofitable. The only one's profiting from them are those who choose to install wind turbines on their property at the expense of every tax payer in this nation. Wind turbines have no place on agricultural land. We farm here and can make an adequate living by working our land. Those farmers who state they are unable to profit from farming and thus must grow "wind turbines" need to work harder at their craft. We have chosen to live in rural America because of a love for the land, and allowing more unsightly wind turbines is damaging to our lifestyle. Why should "neighbors" be allowed to make changes to their property that adversely affects all those surrounding neighbors? We have found that few of our friends and neighbors in Vancycle Canyon are in favor of these wind turbines and the noise and nuisance they bring with them. It is interesting to me that those farmers wishing to build wind turbines on their property don't live near the wind turbines. When they put one in their backyard, perhaps it will make their ideas more credible.

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In conclusion, anyone with common sense and who have any interest in our country and its continuing energy needs, knows that wind power is not the answer. They are not self-sustaining. They cannot bring sustainable jobs without taxpayer subsidies. There is no credible information on how long they will last; if there was there would not be clauses added to contracts for their removal. They are detrimental to the health and well-being of everyone who lives within sight or sound of them. They are a mar on the landscape and they are an insult to the intelligence of rural Americans. Plain and simple, they are a "get cash quick scheme" for a few individuals at the expense of all those around them.

Please reconsider allowing the siting of yet another wind project in our area.

Respectfully submitted,

Jay Spratling
Julia Spratling

3-28-11

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MAR 2 8 2011

UMATILLA COUNTY
PLANNING DEPARTMENT

ROBERT LAZINKA
P.O. BOX 40
PILOT ROCK, OREGON 97868

UMATILLA COUNTY COMMISSIONERS
216 SE FOURTH STREET
PENDLETON, OREGON 97801

COMMISSION MEMBERS:

THE TWO MILE SETBACK FOR WIND TURBINES FROM RURAL HOMES AS ADOPTED BY THE UMATILLA COUNTY COMMISSION IS ENTIRELY APPROPRIATE.

THIS REGULATION PROTECTS THE LIVING QUALITY AND HOMEOWNER PROPERTY VALUES FROM BEING SERIOUSLY DEGRADED.

THE PLANNING COMMISSION IN RECOGNIZING THAT THE PEOPLE LIVING AND PRODUCING ON RURAL LAND HAVE THE RIGHT TO MAINTAIN THESE LIVING QUALITIES IS INSURING A COMPATIBLE ACCOMODATION WITH THE THE WIND ENERGY INDUSTRY.

RESPECTFULLY SUBMITTED,

Robert Lazinka

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BCC

www.wwbwc.org
Walla Walla Basin Watershed Council
541-938-2170 or 7086 P.O.Box 68, Milton-Freewater, OR 97862

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APR 21 2011
UMATILLA COUNTY
PLANNING DEPARTMENT

March 24, 2011

Umatilla County Board of Commissioners
216 SE 4th Street
Pendleton, OR 97801

Dear Umatilla County Board of Commissioners:

Please be aware that the Walla Walla Basin Watershed Council (WWBWC) has significant concerns regarding the potential for industrial-scale energy generation and aggregate development on rural lands near the middle and upper reaches of the Walla Walla River watershed. Extensive development, including many additional miles of roads on slopes draining into the Walla Walla River and its tributaries, could be detrimental to community stakeholders' efforts to protect and restore ESA listed species (Bull Trout and Steelhead). Years of effort and considerable expense to improve fisheries habitat could be significantly degraded. Additionally, efforts of the Confederated Tribes of the Umatilla Indian Reservation to successfully complete their project to re-create a self-sustaining Chinook salmon run in the Walla Walla River, could be adversely impacted. Note that every canyon and "draw" on the west face of the Blue Mountains from the state line south through Pine Creek is a tributary to the Walla Walla River. Additionally, the WWBWC has concerns relating to the potential impacts on terrestrial, avian, and aquatic organisms that utilize this area for rearing habitat or migratory passage. Oregon Department of Fish and Wildlife completed the Oregon Conservation Strategy in 2006. This statewide plan prioritized two conservation opportunity areas for fish and wildlife habitat conservation in the Walla Walla watershed. ODFW also has identified elk winter range in the same areas being considered for wind generation facilities. The Natural Resource Conservation Service has ranked most of the area that drains into upper Walla Walla River, Couse Creek, and Dry Creek as High or Moderately High Erosion Risk. See attached maps (ESA protected steelhead critical habitat, ESA protected bull trout critical habitat, Chinook salmon habitat, critical wintering range for elk, steep slopes, high erosion risk, and drinking water protection). Last but not least is the concern of fire danger as wind turbines periodically ignite, often with no wind company staff in the vicinity to report or suppress the resulting wildfire.

Over $25 million in state, federal, and BPA funds have been spent in the last decade improving watershed conditions in the Walla Walla watershed for water quality, water quantity, fish passage, and fish and wildlife habitat. Extensive development with many miles of new roads has a probability of off-setting the improvements that have been made. Many of these improvements were necessary to avoid federal Endangered Species Act enforcement actions.

The WWBWC also has concerns regarding the process by which these wind projects are permitted and approved. It appears that permission is granted prior to a full assessment of environmental impacts. This environmental assessment process is not as rigorous as the processes others (e.g.

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irrigators/Habitat Conservation Plan/Environmental Impact Statement/Environmental Assessment) are being subjected to in the Walla Walla Basin. Also it is very unclear what, where and when any pre/post-condition monitoring will be conducted to assess any consequential water quality and environmental impacts arising from a project of this kind.

The WWBWC recommends a moratorium on permitting new industrial development on the most sensitive rural lands of the mid and upper watershed as defined by high erosion risk and critical fish and wildlife habitat until an impact assessment is completed and presented to planning staff, the planning commission and the board of commissioners.

The WWBWC requests to be included in all future processes regarding extensive development anywhere in the Walla Walla watershed. Extensive energy development on the face of the Blue Mountains will have considerably different environmental effects than energy development on the much drier lands in the Wallula Gap area. As such, the planning process and assessment of new projects should reflect this difference.

Sincerely,

John Zerba, Chair, on behalf of the Walla Walla Basin Watershed Council Board

Cc: Tamra Mabbott, Planning Director, Umatilla County Department of Land Use Planning
Clinton Reeder, Chair, Umatilla County Planning Commission

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MAR 22 2011
UMATILLA COUNTY
PLANNING DEPARTMENT

Umatilla County
Department of Land Use Planning

Director
Tamra Mabbott

LAND USE
PLANNING
541-278-6252

CODE
ENDFORCEMENT
541-278-6300

***
Emergency
Management
Division:

EMERGENCY
MANAGEMENT
541-966-3700

CHEMICAL
STOCKPILE
EMERGENCY
PREPAREDNESS
PROGRAM
(CSEPP)
541-567-2084
541-966-3700
1-877-367-2737

Date: January 6, 2011 DRAFT

Development within Watersheds

Identifying potential impacts and agencies managing natural resources in the Walla Walla, Umatilla and John Day Watersheds. Umatilla County, Oregon

Background

Over the past several years, numerous groups and agencies have expressed concern about how development in the Blue Mountains might impact the Walla Walla and Umatilla River watersheds. These include impacts to streams, tributaries, water ecosystems and the fish and wildlife populations that reside in them and impacts to water quality and water supply for irrigated agriculture. Similar concerns have been shared about the potential impact to historical, cultural and archaeological resources.

For example, there is concern that erosion from new road development might increase siltation in the river, reversing years of conservation and rehabilitation efforts and potentially harming habitat of endangered species that live in the river and limiting the ability to irrigate crops.

The concerns expressed to the County Planning Commission were targeted at commercial/industrial wind development. However, the issues and concerns apply to any development. While development requires a land use permit from Umatilla County, there are many other agencies that will require permits and/or consultation.

The purpose of this document is to provide a reference for developers and others with an interest in development in the Walla Walla, Umatilla and John

Day Basin watersheds. Any company or person considering development in a watershed is encouraged to contact the agencies referenced in this document prior to submittal of a land use permit to the County. Agencies will also be notified by the County Planning Office, as required by state law ORS 197.180, commonly referred to as the State Agency Coordination Act.

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Table of Contents

Part I. A description of natural resources that may be impacted by development in a watershed.

Part II. A list of local, state and federal agencies and the local tribal government involved in the watershed;

Part III. The Umatilla and Walla Walla River Watershed: A summary of restoration efforts to date, a compilation of existing reports and other reference materials on natural resources in the Walla Walla River watershed.

Part IV. The John Day Basin Watershed: A summary of restoration efforts to date, a compilation of existing reports and other reference materials on natural resources in the John Day Basin watershed.

Part I. Natural resources that may be impacted by development in a watershed.

-Wildlife impacts, direct mortality, cumulative impacts, habitat disruption (Terrestrial, avian, aquatic - species and habitats)

-Water quality (Drinking water protection, toxic laden sediment transport, sedimentation impacts for irrigation and for aquatic species)

-Water quantity (surface water runoff timing, disruption to subsurface hydrogeology of springs, deep and shallow aquifer disruption from drilling into basalt rock formations, water source for construction and for dust control during construction)

-Soil erosion, mass wasting of highly erodible soils and steep hillsides, impervious surfaces and new roads contributing to an increased intensity of flooding

- loss of farmland and pasture

- loss of crops/pasture to displaced elk and deer

- increased opportunity of wildfires from increased mechanized activity and vehicle traffic

- increased herbicide applications for weed control

- increase fire potential and increase complication to suppress fire if crews are delayed by fences and gates

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Part II. Federal, state and local agencies and tribal government involved with the management, regulation and restoration of watersheds. The following entities have either a direct regulatory role or other investment in the watershed. The list is not complete, but is intended to be a guide or general checklist to consider before designing a development project in the basin.

Federal Agencies

United States Fish & Wildlife Service (USFWS) - Bull Trout Recovery Plan

National Oceanic and Atmosphere Administration (NOAA) and National Marine Fisheries Service (NMFS) - Mid-Columbia Steelhead Recovery Plan

Environmental Protection Agency (EPA) – Water Quality and Total Maximum Daily Load (TMDL) reduction

Natural Resources Conservation Service (NRCS) - best practices, road standards

Tribal Government

Confederated Tribes of the Umatilla Indian Reservation (CTUIR) – hunting grounds, fish, wildlife, plant gathering and cultural resources.

State of Oregon Agencies

Oregon Department of Fish & Wildlife (ODFW) – Steelhead, Bull Trout, deer and elk, Critical Winter Range for deer and elk habitat

Oregon Water Resources Department (OWRD) – water rights

Oregon Department of Forestry (ODF) – Forest Practices Act, Fire Prevention and

Risks

Oregon Department of Environmental Quality (DEQ) – Water Quality, TMDL, 303D Streams

Oregon Division of State Lands (DSL) - wetlands

Oregon Office of Energy (OOE) - permitting of large scale energy projects and large transmission lines

Oregon Department of Land Conversation and Development (DLCD) – land use and statewide planning goals

Oregon Department of Agriculture (ODA) – farming practices and implementation of water quality management plan

Oregon Watershed Enhancement Board (OWEB) – grant funding for watershed projects

Oregon Parks Department (OPD) Map of Oregon Trail

Local Government

Umatilla County Department of Land Use Planning – land use permitting

- Comprehensive Plan (Land Use Plan)
- Technical Report of the Comprehensive Plan
- Umatilla County Development Ordinance
  - EFU Zone
  - Grazing Farm Zone
  - Steep Slope Overlay Zone
  - Critical Winter Range Overlay Zone
  - Flood Hazard Overlay Zone
  - Historic, Archaeological, Cultural Resources (HAC) Overlay Zone
  - Natural Area Overly Zone
- Goal 5 Resources – See maps in Comprehensive Plan

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Umatilla County Road Department – use of county roadways, road access permits

Cities near development – water supply, tourism, quality of life, commerce

Umatilla County Weed Department- County Noxious Weed identify and treatment

Other

Walla Walla Basin Watershed Council – water shed restoration and enhancement

Walla Walla Alliance

Umatilla Basin Watershed Council- Watershed restoration and enhancement.

North Fork John Day Watershed Council-

Umatilla County Soil and Water Conservation District

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Resources Materials for Development within Watersheds

Fish and Wildlife Habitat Assessments and Conservation Plans

Oregon Conservation Strategy, ODFW, February 2006. Statewide strategy for conserving fish and wildlife species and their habitats.

-Conservation Opportunity area CP-09, Walla Walla River and canyons is described on page 171, key habitats aquatic, grasslands, riparian and wetland. Key species bull trout, steelhead, redband trout, margined sculpin

-Conservation Opportunity Area BM-17, Umatilla-Walla Walla area, includes the headwaters of the Umatilla and Walla Walla River and extends north to the ecoregion

border, spawning habitat for steelhead and Chinook salmon. Key habitats include aquatic, grasslands, riparian, wetlands and wet meadows. Species: Lewis's woodpecker, bull trout, margined sculpin, spring Chinook salmon, steelhead, American Marten.

Identified in other planning efforts:

American Fisheries Society Aquatic Diversity Areas

Interior Columbia Basin Ecosystem Management Project (plant biodiversity and plant endemism area)

Oregon Biodiversity Project Conservation Opportunity Areas

The Nature Conservancy Ecoregional Assessment

Umatilla Basin Grassland Shrubsteppe Riparian Report EPA, ONHI ODFW 2000

Mid-Columbia Steelhead Recovery Plan

Draft Bull Trout Recovery Plan

Walla Walla Temperature TMDL

Walla Walla Sediment TMDL

Walla Walla Toxics TMDL

Umatilla Temperature (and sediment?) TMDL

Walla Walla Subbasin Plan

Umatilla Subbasin Plan

Highly Erodible Soils/Slopes Report John Bolte OSU

Walla Walla Flow Feasibility Study, USACE/CTUIR

The Nature Conservancy Report on Wind Development and Birds, Eastern Washington

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Walla Walla Basin Watershed Council Strategic Action Plan

Walla Walla Assessment and Action Plan BOR

SB 1010 Agriculture and Water Quality Plan, ODA

South Fork Walla Walla River Area of Critical Environmental Concern, US BLM

Draft Walla Walla River Habitat Conservation Plan (includes section on existing county regulations, etc.)

Western Governor's Corridor's Initiative, see map OR_wildlife.jpg

USFWS enforcement of the Migratory Bird Treaty Act

Oregon Columbia Plateau Ecoregion Wind Energy Siting and Permitting Guidelines September 29, 2008

USFW Region 1, Chapter 10: Oregon and Washington, Umatilla-Walla Walla Recovery Unit report

July 17, 2009 preliminary report of Goal 5 resources in the Walla Walla Watershed (insert map of existing goal 5 resources).

ODEQ 303 D Streams in Walla Walla Watershed
ODEQ 303D Streams in the Umatilla Watershed

ODEQ 303D Streams in the John Day Watershed

Steelhead Streams (ODFW) in Walla Walla Watershed

Steelhead Streams (ODFW) in Umatilla Watershed

Steelhead Streams (ODFW) in John Day Watershed

Bulltrout Streams (ODFW) in Walla Walla Watershed

Bulltrout Streams (ODFW) in Umatilla Watershed

Bulltrout Streams (ODFW) in John Day Watershed

Walla Walla Basin Slopes

Umatilla Basin SLOPES

Walla Walla Basin Fire Risks (ODF)

Resources Materials for Umatilla Watershed

Umatilla/Willow Subbasin Plan

Umatilla River Total Maximum Daily Load (TMDL) and Water Quality Management Plan, DEQ approved May 2001

Umatilla River TMDL Implementation Long Term Monitoirng Plan

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Part III. The Umatilla and Walla Walla River Watersheds: A summary of restoration efforts to date, a compilation of existing reports and other reference materials on natural resources in the Walla Walla River watershed.

The Umatilla River Watershed is the area drained by the Umatilla River and its tributaries from ridge-top to ridge-top. The Walla Walla River Watershed is the area within the Umatilla River Watershed drained by the Walla Walla River. The Walla Walla Watershed is defined by the State of Oregon as part of the Umatilla Basin Watershed.

Local Investments and actions

Current implementation of actions on-the-ground that benefit Endangered Species Act (ESA) listed Middle Columbia River steelhead and Bull Trout total over $10,000,000 over the last eight years (2002 – 2010). Projects include fish passage projects at irrigation diversions, flow restoration using irrigation efficiency and conversion of savings to instream water rights, aquifer recharge to maintain base stream flow in summer, levee setback to reestablish floodplain connection and riparian habitat, meander reestablishment, moving livestock corrals off of creek banks, assisting local schools with watershed education, reducing pesticide application near streams, monitoring water quality and water quantity, providing input to steelhead recovery planning, outreach, and implementation, providing input to draft Walla Walla River Habitat Conservation Plan, providing input to USACE Walla Walla River Flow Improvement Feasibility Study, providing input to Wind Power siting to reduce impacts to fish and wildlife.

Organizations and government agencies that have been working with landowners to implement these actions have included OWEB, Confederated Tribes of the Umatilla Indian Reservation, ODFW, ODEQ, BPA, EPA, USACE, NOAA, NRCS, USFWS, ODA, Oregon Water trust/Freshwater Trust, NWPPC, Umatilla County, Umatilla County Soil and Water Conservation District.

Similar investments, likely even more funding, by many of the same partners have occurred in the Umatilla Watershed.

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A COUNTY
DEPARTMENT

Revised Proposed Rulemaking Announcement

Revised Water Quality Standards for Human Health Toxic Pollutants and Revised Water Quality Standards Implementation Policies

State of Oregon
Department of
Environmental
Quality

Water Quality Division
Standards and Assessment
Program
811 SW 6th Avenue
Portland, OR 97204
Phone: (503) 229-5384
(800) 452-4011
Fax: (503) 229-6037
Contact: Andrea Matzke
ToxicsRuleMaking@deq.state.or.us

www.oregon.gov/DEQ/

Background
The Oregon Department of Environmental Quality proposes, through this rulemaking, to revise the water quality standards regulation to address the human health criteria for toxic pollutants. DEQ also proposes to adopt new and revised water quality standards rules on implementing water quality standards through various water quality control programs, including National Pollutant Discharge Elimination System (NPDES) permits and nonpoint source pollution programs.

Why are rule changes needed?
DEQ uses water quality standards as the basis to regulate the discharge of pollutants to Oregon water bodies, to evaluate whether water bodies support beneficial uses, such as fishing and household water supply, and to implement other programs to prevent and control water pollution from point (end-of-pipe) and nonpoint sources.

DEQ's currently effective human health toxics criteria are based on a fish consumption rate that does not provide adequate protection for the amount of fish and shellfish consumed by Oregonians. On June 1, 2010, the Environmental Protection Agency (EPA) disapproved human health toxics criteria which Oregon submitted for approval in 2004 and which were based on a fish consumption rate of 17.5 grams per day. EPA disapproved the human health toxics criteria because the fish consumption rate is not considered protective of many Oregonians. DEQ is addressing EPA's disapproval by proposing to use a higher fish consumption rate of 175 g/day to calculate more protective human health toxics criteria. If DEQ does not establish revised criteria, EPA must conduct rulemaking to develop human health toxics criteria for Oregon.

This rulemaking also proposes new rule language and revisions to existing rule language for various NPDES permit implementation tools developed to assist dischargers in complying with revised standards. Further, revisions to the water quality standards and Total Maximum Daily Load (TMDL) rules are intended to make DEQ's rules consistent with state statutes affecting nonpoint sources of pollution and for DEQ to assign pollution load allocations to significant land and air sources in TMDLs.

What is the objective of this rulemaking?
The objective is to adopt water quality standards for Oregon that will protect people from adverse health effects as a result of consuming fish and water from Oregon streams and lakes. In addition, the objective of the rulemaking is to allow DEQ and other agencies to implement the water quality standards in a manner that is cost effective and achieves meaningful environmental results.

Who may be affected?
Cities and businesses that discharge to state waters will be affected by this rulemaking if their discharge contains one or more of the regulated pollutants. Forest and agricultural land managers, transportation and other construction projects and other parties subject to programs that control point and nonpoint sources of pollution could also be affected if their activity results in the transport of regulated toxic pollutants into surface waters. Tribal people and other Oregonians who eat fish and shellfish will benefit from the health protections provided.

How was this proposal developed?
DEQ worked with several advisory committees throughout this process. In developing the revised fish consumption rate, DEQ worked with the *Human Health Focus Group*, a group of public health specialists and toxicologists who advised DEQ in its review of available fish consumption studies. DEQ also assembled the *Fiscal Impact and Implementation Advisory Committee*, a group of affected stakeholders and two economists, to provide input on the fish consumption rate development and on a cost analysis conducted for DEQ by an EPA contractor.

During the development of the revised human health criteria and the implementation tools, DEQ worked with a *Toxics Standards Rulemaking Workgroup* and a *Non-NPDES Workgroup*, both comprised of affected stakeholders. Agendas and meeting summaries for these two workgroups are available on DEQ's website at: http://www.deq.state.or.us/wq/standards/humanhealth.htm.

DEQ and the EQC have the statutory authority to address this issue under ORS 468B.010, 468B.020, 468B.035, 468B.110, and 468.020. These rules implement ORS 468B.048

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Rulemaking materials available

- Proposed Rule Changes
- Statement of Need and Fiscal Impact
- Land Use Evaluation Statement
- Relationship to Federal Requirements

The above documents are available for public comment and provide information about this proposed rulemaking. The documents can be viewed at: http://www.deq.state.or.us/regulations/rulemaking.htm.

Additional materials available

Principal documents DEQ used to develop and support this rulemaking include a set of issue papers. DEQ has also developed draft Internal Management Directive (IMD) outlines for several implementation components of the proposed rulemaking. Other supporting documents include EPA criteria recommendations and the Human Health Focus Group report. These may be found on DEQ's website at: http://www.deq.state.or.us/wq/standards/toxics.htm.

DEQ will post issue papers and draft IMD outlines to the above website by Monday, Jan. 3, 2011. These documents are not for public comment.

The public may review copies of the documents described above at DEQ's headquarters office at 811 S.W. 6th Ave. in Portland. Please contact Andrea Matzke at 503-229-5384, or toll-free in Oregon at 1-800-452-4011, ext. 5384 for times when the documents are available for review.

How to comment

People may submit comments on the proposed rulemaking in writing via mail, fax or e-mail at any time prior to the comment deadline of 5 p.m. Wednesday, Feb.23, 2011. Written and oral comments can be submitted during any of the public hearings specified below. It is not necessary to attend a hearing in order to comment. Written comments received prior to the deadline are treated equally with oral comments.

Mail written comments to Andrea Matzke, Oregon DEQ, Water Quality Division, 811 SW 6th Ave, Portland, OR 97204. Contact Andrea Matzke at 503-229- 5384, or toll-free in Oregon at 1-800-452-4011, ext. 5384.

Fax comments to Andrea Matzke at 503-229-6037, or e-mail comments to: ToxicsRuleMaking@deq.state.or.us.

(DEQ will acknowledge e-mail comments immediately. Limit comments and attachments to 10 MB. If you do not receive an automatic response, or your comments and attachments will exceed this limit, please contact Andrea Matzke at the number listed above.)

If there is a delay between servers, e-mails may not be received before the deadline.

Public hearings

DEQ will hold public hearings in seven cities throughout the state in February. Each hearing will begin with a brief overview of the proposed rule changes, followed by the opportunity for members of the public to provide oral and written comment. DEQ will record and review all comments.

- **Bend**
  1 p.m. Tuesday, Feb. 1, 2011
  Oregon Department of Transportation
  Office, Deschutes River Room
  63055 N. Highway 97
  Bend, OR 97701
- **Eugene**
  9 a.m. Wednesday, Feb. 2, 2011
  DEQ Eugene Office
  Willamette Conference Room
  165 East 7th Ave., Suite 100
  Eugene, OR 97401
- **Medford**
  6 p.m. Wednesday, Feb. 2, 2011
  DEQ Medford Office
  Large Conference Room
  221 Stewart Ave., Suite 201
  Medford, OR 97501
- **Coos Bay**
  1:30 p.m. Thursday, Feb. 3, 2011
  City Hall, Council Chambers
  500 Central Ave.
  Coos Bay, OR 97420
- **Ontario**
  2:30 p.m. Mountain Standard Time
  Monday, Feb. 7, 2011
  Ontario City Hall
  Council Chambers (2nd floor)
  444 SW 4th St.
  Ontario, OR 97914

Version: 01/20/11
A. Matzke

- **Pendleton**
  2 p.m., Tuesday, Feb. 8, 2011
  St. Anthony's Hospital
  Cascade Room (1st floor)
  1601 SE Court Ave.
  Pendleton, OR 97801
- **Portland**
  6 p.m., Thursday, Feb.10, 2011
  DEQ Headquarters, Rm EQC-A (10th floor)
  811 SW 6th Ave.
  Portland, OR 97204
- **Portland**
  EQC Meeting
  1:30 p.m., Wednesday, Feb.16, 2011
  DEQ Headquarters, Rm EQC-A (10th floor)
  811 SW 6th Ave.
  Portland, OR 97204

Comment deadline is Feb. 23, 2011

All comments are due to DEQ by 5 p.m. Wednesday, Feb. 23, 2011. DEQ cannot consider comments from any party **received** after the deadline for public comment.

How will rules be adopted?

DEQ will prepare a response to all comments received during the public hearing and comment period and may modify the proposed rules. DEQ plans to recommend that the Oregon Environmental Quality Commission adopt the rules at the commission's June 2011 meeting. DEQ will notify persons of the time and place for final EQC action if they submit comments during the hearing or comment period or request to be placed on DEQ's mailing list for this rulemaking.

Accessibility information

DEQ is committed to accommodating people with disabilities. Please notify DEQ of any special physical or language accommodations or if you need information in large print, Braille or another format. To make these arrangements, contact DEQ Communications and Outreach office, Portland, at 503-229-5696 or call toll-free in Oregon at 800- 452-4011, ext. 5696; fax to (503) 229-6762; or e-mail deqinfo@deq.state.or.us. People with hearing impairments may call 711.

March 30, 2010

State of Oregon
Department of
Environmental
Quality

Draft Rulemaking Timeline

Human Health Toxics Criteria and Implementation Rulemaking

Milestone	Deliverables	Completion Date
Develop draft proposed rules, supporting documents, implementation plan & fiscal impact statement.	Draft proposed rules supporting documents implementation plan statement of need and fiscal impact	Oct 27, 2010
Draft rule package for internal, EPA, and AG review	Draft rule package for Secretary of State (SOS)	Nov 17, 2010
Final rule package for internal review	Final rule package for SOS	Dec 8, 2010
Prepare for public comment	Rulemaking documents sent to SOS Notice published in SOS bulletin	**Dec 15, 2010** Jan 3, 2011
Public comment and hearings	Public comment period (est.) Public hearings (est.)	Jan 3 - Feb 24, 2011 Jan 18 - Feb 15, 2011
Response to public comment and final proposed rules	Response to public comment final proposed rules supporting documents implementation plan	April 29, 2011
EQC informational presentation	staff report and presentation EQC Meeting	March 22, 2011 April 29 – 30, 2011
EQC action item	Staff report and presentation EQC meeting and rule adoption	May 10, 2011 **June 16 -17, 2011**
Submit revised standards to EPA for approval	AG certification of rule adoption rules filed with SOS submittal package to EPA	July 22, 2011

Water Quality Standards Rulemaking: Revising Human Health Toxics Criteria

Questions and Answers

1. What are water quality standards?

Water quality standards establish goals for Oregon's surface waters such as protecting communities of fish and other organisms that live in the water, sources of drinking water and helping ensure that the fish we eat from Oregon waters is safe. DEQ's proposed revisions set levels of toxic pollutants within the waters (also known as the human health criteria) that allow the state to meet the goals of eating fish and drinking water.

2. How does DEQ ensure that Oregon waters meet the water quality standards?

DEQ ensures these levels are met by putting in place requirements for sources of these pollutants. Two important ways DEQ accomplishes this is by issuing permits to facilities that discharge treated wastewater, also known as National Pollutant Discharge Elimination System (NPDES) permits, and by developing clean water plans, also known as Total Maximum Daily Loads (TMDLs), when data or information indicate the water body does not meet its goal. In addition, DEQ works with land management agencies such as the U.S. Forest Service and Oregon Department of Transportation, as well as regulatory agencies such as the state Departments of Forestry and Agriculture, to prevent nonpoint source pollution.

3. What will this rulemaking do?

This rulemaking revises the state's toxics water quality criteria to protect the ability of Oregonians to consume fish as a regular part of their diet and the ability of communities to obtain drinking water from Oregon streams and lakes without adverse health effects caused by toxic pollutants. This rulemaking also proposes several new and revised implementation tools to assist wastewater and industrial dischargers in complying with new water quality standards. Because toxic pollutants also come from nonpoint sources of pollutants such as agricultural, forestry and construction activities, DEQ is revising elements of the water quality standards and pollution load allocation (Total Maximum Daily Load) rules to clearly state that best management practices and other control measures established by the Oregon Department of Forestry must not violate water quality standards. Further, state Agricultural Water Quality Management Act plans must be designed to achieve and maintain water quality standards. These changes make DEQ's rules consistent with existing state statutes.

4. What are toxic water pollutants? Which toxic pollutants is DEQ concerned about?

Toxic water pollutants are chemicals discharged into waters in amounts that can be harmful to fish, wildlife or people. They can come from "point" discharge sources such as municipal wastewater treatment plants and industrial facilities, or "nonpoint" activities such as agriculture, forestry and construction activities. Some toxic pollutants are naturally occurring, but many were manufactured for use in industry or agriculture, or for personal uses such as hygiene and medical care. These synthetic and naturally occurring chemicals can be concentrated to toxic levels and transported to streams through human activities such as mining or wastewater treatment and through natural processes such as erosion.

Toxic pollutants of concern addressed by this rulemaking include methylmercury (produced from the burning of fossil fuels), bis (2-ethylexyl) phthalate (a plasticizer), benzo (a) pyrene, chlordane, toxaphene, dioxin, and now-

banned pollutants such as PCBs, the pesticide aldrin and insecticide DDT, which remain in the environment as persistent and bioaccumulative toxics. These "PBTs" can build up in the food chain to levels that are harmful to human and ecosystem health. They can also be transported long distances and can move between land, air and water. Because of their persistent and bioaccumulative properties, these pollutants do not break down easily and are particularly difficult to clean up. Many of these substances are human-made and have only been in existence for a relatively short period of history. Others are natural elements, such as mercury. It is the refinement and concentrated human use of these substances that creates the problem.

5. What are the human health effects of toxic contaminants?

Many of the toxics criteria pollutants cause cancer. Others can cause adverse health effects on the immune system, reproductive system, nervous system or endocrine system. Mercury can affect the nervous system and the brain; even low doses can impair the physical and mental development of human fetuses and infants exposed via their mother's diet. DDT has been linked to neurological and developmental disorders in birds and other animals. Additional information on the health effects of toxic substances may be found in the Human Health Focus Group report (available on DEQ's water quality standards/toxics web page) and on EPA's water quality criteria websites.

6. Why is DEQ proposing this rule?

DEQ's current human health toxics criteria do not provide adequate protection for Oregonians who eat fish and shellfish on a regular basis. These proposed revisions will address concerns expressed by Tribes and the U.S. Environmental Protection Agency about previous criteria DEQ adopted in 2004, which were not protective because they were based on a low fish consumption rate (17.5 grams per day or 2.3 8-ounce fish or shellfish meals per month).

In June 2010, EPA disapproved the 2004 criteria based on these concerns, causing Oregon to revert back to an even less-protective fish consumption rate of 6.5 g/day. This rule addresses EPA's disapproval by proposing to adopt significantly more protective human health toxics criteria based on a higher fish consumption rate of 175 g/day (23 8-ounce meals per month). If DEQ does not revise the criteria, EPA must adopt human health toxics criteria for Oregon.

7. Will this rule result in the reduction of toxic pollutants?

Not all pollutants addressed by this rulemaking will need reduction, although there are some that DEQ is aware of that will likely need further reduction (see Question #4). For many pollutants, actions are already occurring to reduce these pollutants. This rulemaking will result in requirements to continue those efforts and, where the pollutants are found at high levels, additional actions may be needed to reduce levels of those pollutants.

8. When do the new criteria become effective?

The proposed rules would become effective upon EPA approval. DEQ will request that the Oregon Environmental Quality Commission adopt the rule in June 2011. EPA would likely complete its review by fall 2011 or early 2012.

9. Who is affected by these rules?

Oregonians who eat fish and shellfish on a regular basis will benefit from the health protections provided by the revised human health criteria. Cities, businesses and other facilities that discharge to state waters will be affected by this rulemaking if their discharge contains one or more of the regulated toxic pollutants. Forest and agricultural land managers, transportation and other construction projects and other parties subject to programs that control point and nonpoint sources of pollution could also be affected if their activity results in the transport of regulated

toxic pollutants to surface waters. Residents and consumers may also be affected in cities that implement pollution reduction programs or enhance their wastewater treatment.

10. How much will the new rules cost?

The potential cost of the new rules will vary widely depending on the pollutants, the source of the pollutants and whether additional actions are needed to help achieve the new standards. DEQ has compiled a "Fiscal and Economic Impact Statement" that is available on its website and describes potential fiscal impacts and estimated costs, where known.

Additional water bodies in Oregon may be listed as "impaired" for toxic pollutants in the future, leading to an increase in the subsequent number of TMDLs developed to meet toxics load allocations. Entities identified to participate in the TMDL may include Oregon Department of Agriculture, Oregon Department of Forestry, the U.S. Bureau of Land Management, U.S. Forest Service, municipalities and irrigation districts. These agencies may need additional resources in order to conduct TMDL implementation monitoring and best management practice effectiveness monitoring. It is difficult to quantify the potential costs to these agencies or other significant pollutant sources until data is collected and analyzed. It is likely that many of the management practices to control toxics from nonpoint sources will be the same under the new criteria as they would be to meet current criteria.

11. How did DEQ develop the fish consumption rate of 175 grams/day, and how does it protect all Oregonians?

Between 2006 and 2008, DEQ conducted an extensive outreach and information gathering project in collaboration with EPA and the Confederated Tribes of the Umatilla Indian Reservation. It held seven public workshops to solicit broad public input and consulted with two advisory groups; one focused on evaluating public health data and information and the other focused on evaluating economic impacts and implementation strategies.

From these workgroup discussions and analysis of fish consumption studies, DEQ concluded that a fish consumption rate of 175 g/d, or about 23 8-oz fish meals per month, is a reasonable and protective rate to use as the basis for Oregon's human health criteria.

The EPA, CTUIR, and DEQ issued a joint recommendation to the Environmental Quality Commission on Oct. 23, 2008 to revise Oregon's toxics criteria for human health based on a fish consumption rate of 175 g/d. The commission agreed with this recommendation and directed DEQ to proceed with a rulemaking process to revise the criteria.

175 grams per day represents the 95th percentile value from a comprehensive study of Columbia River Tribes (the Columbia River Inter-Tribal Fish Commission study) and is within the range of the 90th percentile values from other Northwest studies. The 175 g/d rate is consistent with public health experts' recommendations to:

- use 90th or 95th percentile values to represent the proportion of the population the criteria should be designed to protect,
- use a fish consumption rate that represents fish consumers, rather than a per capita rate derived from the overall population including both consumers and non-consumers of fish, and
- include salmon and other marine species in the rate.

12. Does the fish consumption rate vary geographically? If not, why?

No, the fish consumption rate does not vary geographically across the state. Although DEQ and stakeholders discussed the idea of applying different consumption rates for different geographic areas within the state, DEQ did

not pursue this option because nearly all the major river basins in Oregon are usual and accustomed fishing areas for an Oregon tribe. In addition, people may catch fish in many locations around the state and not just in the river basin in which they live. Another factor in applying the fish consumption rate to all waters of the state is that having different criteria in different basins can create complexities in the regulations and its implementation.

13. Why were salmon and other marine fish included in the fish consumption rate?

Salmon and other marine fish spend the majority of their life cycle in the ocean, where they have the potential to be exposed to toxic pollutants accumulated over their lifetime. However, DEQ and stakeholders recommended that salmon and marine fish be included in the fish consumption rate because these fish are an important part of the fish diet in the Northwest. Also, these fish spend some portion of their life in Oregon fresh and coastal waters and thus may be exposed to contaminants.

14. Do any other states use this fish consumption rate?

No other state is using this fish consumption rate. As a result, Oregon will have the most stringent human health toxics criteria of any state in the country. Other states with fish consumption rates that are higher than the EPA nationally recommended rate of 17.5 g/day are in the 30 - 33 g/day range. The EPA has approved a fish consumption rate of 389 g/day for the Confederated Tribe of the Umatilla Indian Reservation and a rate of 170 g/day for the Warm Springs Indian Reservation. Both tribes are in Oregon.

15. Not everyone eats this much fish from Oregon waters. Why is it set so high?

A fish consumption rate of 175 g/day protects 90 to 95 percent of Oregon's population who regularly eat fish and shellfish. DEQ acknowledges that not all Oregonians eat fish, or eat less fish than this population. The Oregon Environmental Quality Commission agreed with this rate and directed DEQ to use a fish consumption rate of 175 g/day to protect all Oregonians, rather than using a per capita consumption rate of the total population and including people who do not eat fish or eat it rarely.

16. How can dischargers meet these very low toxic criteria?

Some dischargers may already be able to meet requirements based on the revised criteria; other dischargers may use pollutant source reduction or treatment technologies, or a combination of these approaches to comply with new requirements. The options available will vary depending on the pollutant and the source of that pollutant. In some cases, if treatment technologies or other approaches are not available that would result in meeting the new requirements, DEQ will pursue with the source other approaches that will allow the facility to comply with its requirements while continuing to make progress toward meeting the standards (e.g., compliance schedules, variances with pollutant reduction plans—see question #10).

17. What if a discharger cannot meet revised criteria for a toxic pollutant?

In some cases, a discharger will need time to implement pollution reduction programs or to install new treatment systems. DEQ can put a schedule of actions in a permit that allows the discharger to operate until these actions can be put in place and result in reducing pollutant concentrations.

In some cases, a discharger may find that there are no options that will lead to meeting the criteria, or that the options available are not affordable. DEQ is proposing two administrative tools to assist dischargers in this position. The first, a variance, is a tool that is already available in Oregon and has been used many times in other states. DEQ is proposing rule revisions to clarify the variance procedures and make this a more usable alternative. This approach will allow a discharger to put in place affordable treatment technologies and actions that will result in progress toward meeting the pollutant goals, but not require the use of prohibitively expensive treatment. DEQ will use this tool where appropriate and has EPA support for this approach. The second tool is a background

pollutant allowance water quality standard. This rule allows a very small incremental increase in the concentration of pollutants in the water body in situations where the pollutant was taken into the facility in its water supply and the facility does not add more of the pollutant to its discharge.

18. How will DEQ manage the anticipated workload associated with permit compliance and enforcement?

Reducing toxic pollutants in Oregon waters is a DEQ priority. DEQ will continue to manage its resources and priorities to address increased workloads where they occur. These revised rules will result in changes in requirements and actions over time (e.g., upon permit expiration and renewal). In some cases, the resource requirements will not result in differences from DEQ's implementation of the current rules. By clarifying the variance provision and adopting the background pollutant allowance, permit writers will have clearer direction and guidance to address these situations. In addition, DEQ anticipates that EPA will be able to assist with some aspects of implementation, such as the economic analysis required for some variances. EPA has provided this assistance for other states.

19. Will landowners be given load allocations to comply with a TMDL?

DEQ anticipates that it will work with ODF for non-federal forests, ODA for agricultural lands, and other designated management agencies to implement TMDLs. Although DEQ has authority under Oregon Administrative Rule 340-042 to assign load allocations to sources, including individual landowners, DEQ believes it is more efficient to use existing programs such as Oregon Forest Practices Act rules and Agricultural Water Quality Management area plans and rules to meet load allocations for nonpoint sources. DEQ will provide opportunities for ODA and ODF to develop implementation strategies for landowners to meet load allocations.

20. Do the revisions related to forestry and agriculture best management practices and other control measures provide DEQ with additional authority?

No. The revisions to the water quality standards and pollution load allocation (Total Maximum Daily Load) rules makes more clear how DEQ will interact with the state Departments of Agriculture and Forestry to use the agencies' respective authorities to achieve water quality standards. In addition, the rules make clear that best management practices and other control measures established by the Oregon Department of Forestry must not violate water quality standards. Further, the rules state that Agricultural Water Quality Management Act plans must be designed to achieve and maintain water quality standards. These changes make DEQ's rules consistent with existing state statutes.

21. What happens if implementation of Best Management Practices established by ODF or implementation strategies for Agricultural Water Quality Management Area plans do not show progress toward the water bodies to meet water quality standards?

TMDL implementation is a developing, often phased-in process and DEQ expects that adjustments will be needed over time to attain water quality standards. If TMDL milestones and timelines are not being met, DEQ will work with sources, including ODF or ODA, to determine whether additional measures or resources are needed to meet TMDL milestones and load allocations and to attain water quality standards in the water body.

22. What is EPA's role in this rulemaking?

EPA will review and approve or disapprove Oregon's water quality standards, as required by the federal Clean Water Act. DEQ anticipates that EPA will act within approximately six months of adoption by the Environmental Quality Commission. EPA must ensure that the criteria protect fishing, swimming and other uses of the nation's waters and serve the act's goal "to restore and maintain the physical, chemical and biological integrity of the

nation's waters." EPA sets national water quality criteria recommendations for toxic pollutants and has published guidance for how states should establish human health criteria.

Because EPA disapproved most of the human health toxics criteria that DEQ submitted in 2004, it must set criteria for the state if Oregon does not revise the disapproved criteria within a reasonable time frame (Summer 2011).

23. Will EPA approve these new standards?

DEQ has worked closely with EPA at all levels in developing these new criteria and standards. EPA is supportive of DEQ's efforts and prefers that Oregon adopt revised toxics criteria for human health rather than EPA acting on behalf of the state. EPA has provided feedback throughout the toxics criteria review and development project; that feedback is reflected in the proposed rule revisions.

24. I understand there is a lawsuit related to this rulemaking. What effect does it have on Oregon's rulemaking efforts and timeline?

In 2006, Northwest Environmental Advocates filed suit against EPA because EPA had not acted on the toxics water quality standards DEQ adopted in 2004. EPA and Northwest Environmental Advocates entered into an agreement that required EPA to approve or disapprove Oregon's 2004 standards. EPA did not immediately act since DEQ was already underway with revisions to those standards. EPA expressed a strong preference for Oregon to complete their work to adopt more protective toxics criteria. The Clean Water Act gives primary responsibility for setting water quality standards to the states. In June 2010, EPA disapproved the majority of DEQ's human health criteria for toxic pollutants. They concluded that the fish consumption rate used to set the 2004 criteria was inadequate to protect all Oregonians based on the amount of fish and shellfish some are known to consume. EPA's June action addressed their obligation under the litigation.

The proposed human health criteria for toxic pollutants will address EPA's disapproval. Without revisions to Oregon's water quality standards to address EPA's disapproval, EPA must develop establish standards for Oregon.

25. What happens if DEQ does not complete this rule in a timely fashion?

The proposed human health criteria for toxic pollutants will address EPA's disapproval. In addition to revising the numeric human health criteria, DEQ is proposing rules that will be used to implement these criteria. Oregon is working to adopt the more protective fish consumption rate and toxics criteria by summer 2011. This is a critical deadline. If it is not met, EPA is prepared and required to step in and adopt protective toxics criteria for Oregon. If this occurs, it is likely that EPA would include in its rule only the numeric criteria values. DEQ feels it is important to complete this rulemaking on its stated schedule in order to adopt its own criteria and to address the key implementation issues. While EPA is ready to step in if needed, EPA strongly supports Oregon's efforts to adopt state rules by summer 2011.

26. How does this rulemaking relate to the separate DEQ water quality rulemakings to revise human health criteria for arsenic, iron and manganese?

DEQ expedited revisions to the arsenic, iron and manganese criteria, adopting final revisions for iron and manganese in December 2010. DEQ will reopen the public comment period on arsenic by the end of January 2011. The expedited rulemakings for arsenic, iron and manganese human health criteria will result in criteria that continue to protect health and address the naturally-occurring concentrations of these pollutants. DEQ withdrew the iron and manganese human health criteria that are not necessary to protect human health. Proposed revisions to the arsenic criteria incorporate the same higher fish consumption rate being used to revise the other toxics criteria in order to protect fish consumers. In addition, the proposed arsenic criteria are based on other scientific information and policy considerations to account for the presence of natural sources of arsenic in Oregon waters

and to balance the goals of human health protection and a program that is cost effective and will achieve environmental results.

27. What else is DEQ doing to address toxic pollutants in Oregon?

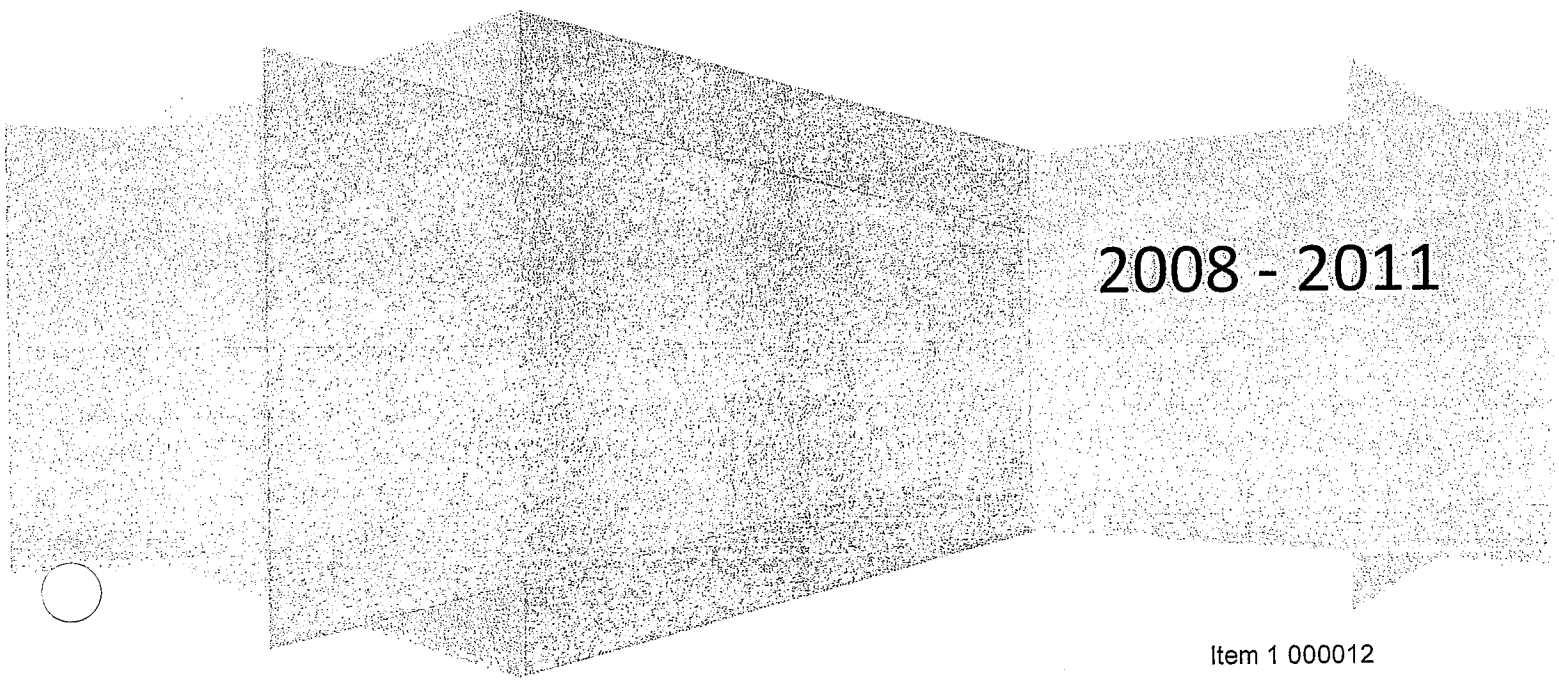
DEQ is developing an agency-wide toxics reduction strategy using a comprehensive and integrated approach to determine how to most effectively and efficiently reduce the release of priority toxics to Oregon's air, land and water. Recommendations from this agency-wide strategy could include enhancing existing toxics programs; adding new voluntary, incentive or regulatory programs; and improving the alignment/coordination of all toxics reduction programs. Additional information is on DEQ's website: http://www.deq.state.or.us/toxics/index.htm.

DEQ also has several programs already underway that contribute to controlling and reducing toxics in Oregon's environment, including the water quality standards rulemaking, water quality's Priority Persistent Pollutants project, the Portland Air Toxics Solutions project, Clean Diesel initiatives, product stewardship initiatives (e.g., electronic and paint waste recycling), household and small business hazardous waste collection events, the watershed-based Pesticide Stewardship Partnership Program, the state drinking water source protection program, the Toxics Use and Hazardous Waste Reduction Program, hazardous waste management compliance activities, the contaminated site cleanup program and others.

December 29, 2010

Executive Summary

Human Health Toxics Rulemaking



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1. Introduction

DEQ is proposing revisions to Oregon's water quality standards and related regulations. Water quality standards establish goals for Oregon's surface waters such as protecting communities of fish and other organisms that live in the water, sources of drinking water and helping ensure that the fish we eat from Oregon waters is safe. DEQ's proposed revisions set levels of toxic pollutants (also known as the human health criteria) that allow the state to meet the goals of eating fish and drinking water.

DEQ ensures these levels are met by putting in place requirements for sources of these pollutants. Two important ways DEQ accomplishes this is by issuing permits to facilities that discharge treated wastewater, also known as National Pollutant Discharge Elimination System or NPDES permits, and by developing clean water plans, also known as Total Maximum Daily Loads or TMDLs, when data or information indicate the water body does not meet its goal. In addition, DEQ works with land management agencies such as the U.S. Forest Service and ODOT, as well as regulatory agencies such as Departments of Forestry and Agriculture to prevent nonpoint source pollution.

The proposed rules, if adopted, will affect requirements for sources of toxic pollutants including cities and businesses that discharge wastewater if their discharge contains one or more of the regulated pollutants. Forest and agricultural land managers, transportation and other construction projects and other parties subject to programs that control point and nonpoint pollution sources could also be affected if their activity results in the release of regulated toxic pollutants into surface waters. DEQ is proposing changes to its water quality standards regulation as well as some targeted changes to its NPDES and TMDL regulations to address how these new standards would be implemented by sources.

DEQ initiated this work in 2006 in response to U.S. Environmental Protection Agency's and many Tribes' concerns that DEQ's 2004 regulations addressing toxic pollutants did not adequately consider the amounts of fish people eat when setting criteria to protect the goal of safely eating fish. Since that time, DEQ has been working with EPA, Tribes, particularly the Confederated Tribes of the Umatilla Indian Reservation, interested members of the public, and experts in the public health field. DEQ's first objective was to identify the appropriate fish consumption level, or rate, and then develop regulations that would establish that rate as part of its water quality goals. The proposed rules represent the work done over the past four years to meet these objectives.

2. Background

The Federal Clean Water Act

The federal Clean Water Act requires states to develop and, from time to time, revise state water quality standards. While the Act requires states to develop and adopt the regulations, EPA retains an oversight role and must approve the regulations before states can implement them.

Water quality standards contain three major components: (1) the uses (or goals) assigned to the state's waters, such as recreation, protection of fish and other aquatic organisms, and public water supply (the

terms "designated uses" or "beneficial uses" are frequently used to describe the goals); (2) the pollutant concentrations associated with protection of the assigned uses (e.g., water quality criteria); and (3) procedures to ensure water quality is maintained and that also govern how and in what circumstances DEQ may allow a source to degrade water quality (known as the "antidegradation policy"). DEQ implements these water quality standards components and places requirements on sources where needed to achieve the state's water quality goals.

Oregon's water quality standards predate the 1972 federal Clean Water Act, and over the years, DEQ has revisited them to reflect new science and information. Frequently, EPA is the source of new information. With regard to criteria specifically, EPA continuously reviews scientific data and information used to establish criteria for human health protection and to protect communities of fish and other organisms that live in the water. Based on these reviews, EPA publishes criteria recommendations and the values used to calculate the criteria. The types of values EPA publishes include a fish consumption rate as well as values accounting for the amount of water people may drink, body weights, and, for pollutants that are known to be cancer-causing, a risk rate (e.g., one excess cancer case in one million people). States, including Oregon, typically use these EPA recommended criteria and values when adopting their own water quality standards.

While water quality standards express the desired water quality of the state's waters, DEQ works to achieve these goals through a number of other Clean Water Act programs. First, DEQ administers the NPDES permitting program. DEQ places requirements in NPDES permits to ensure that the discharged wastewater is clean enough to meet water quality standards. In instances where DEQ does not issue a permit to a discharger or for an activity (for example, when the Army Corps of Engineers issues permits to entities that dredge river sediments), DEQ must "certify" that the permit being issued by the other regulatory authority contains sufficient requirements to meet the state's water quality standards. In cases where DEQ looks at data and information and concludes a stream or lake's water quality does not meet water quality standards, DEQ must develop a pollutant budget, or TMDL, that allocates allowable pollutant loads to sources within the water body or watershed.

Other State Requirements and Programs

In addition to the activities that DEQ carries out, other agencies within Oregon also have a responsibility to carry out activities to meet water quality standards. The Oregon Department of Agriculture must revise and implement Agriculture Water Quality Management Plans and rules. These plans provide guidance, while the rules provide an enforceable backstop to resolve water quality issues. The Oregon Department of Forestry implements the state's Forest Practices Act by providing guidelines and management practices to operators managing state and private forest lands to prevent water quality issues through administrative rules.

DEQ works closely with the other state agencies in implementing the state and federal laws governing water quality.

DEQ's Efforts on Toxic Pollutants

The rules DEQ is proposing to address toxic pollutants through water quality standards and its implementing programs is only one area in which DEQ is working to address sources of toxic pollutants. Concurrent to this effort, DEQ is developing an Agency-wide Toxics Reduction Strategy. DEQ is identifying priority pollutants and opportunities for pollutant reduction efforts and will align resources and programs within the Agency to address those priority actions. The toxic pollutants directly addressed by this water quality standards rulemaking have also been identified as priority pollutants for the entire Agency. As a result, some of the actions proposed in the Toxics Reduction Strategy will help achieve the goals of the rulemaking.

DEQ anticipates completing a draft strategy in April 2011. This draft will outline specific actions DEQ proposes to reduce toxic chemicals and pollutants in Oregon's water, land and air. These actions will involve all of DEQ's divisions, as well as partnerships with other agencies and organizations. Development of revised water quality standards regulations is one component of DEQ's overall efforts to address and reduce toxic pollutants. Please see Figure 1 below which illustrates DEQ's Toxics Reduction Strategy.

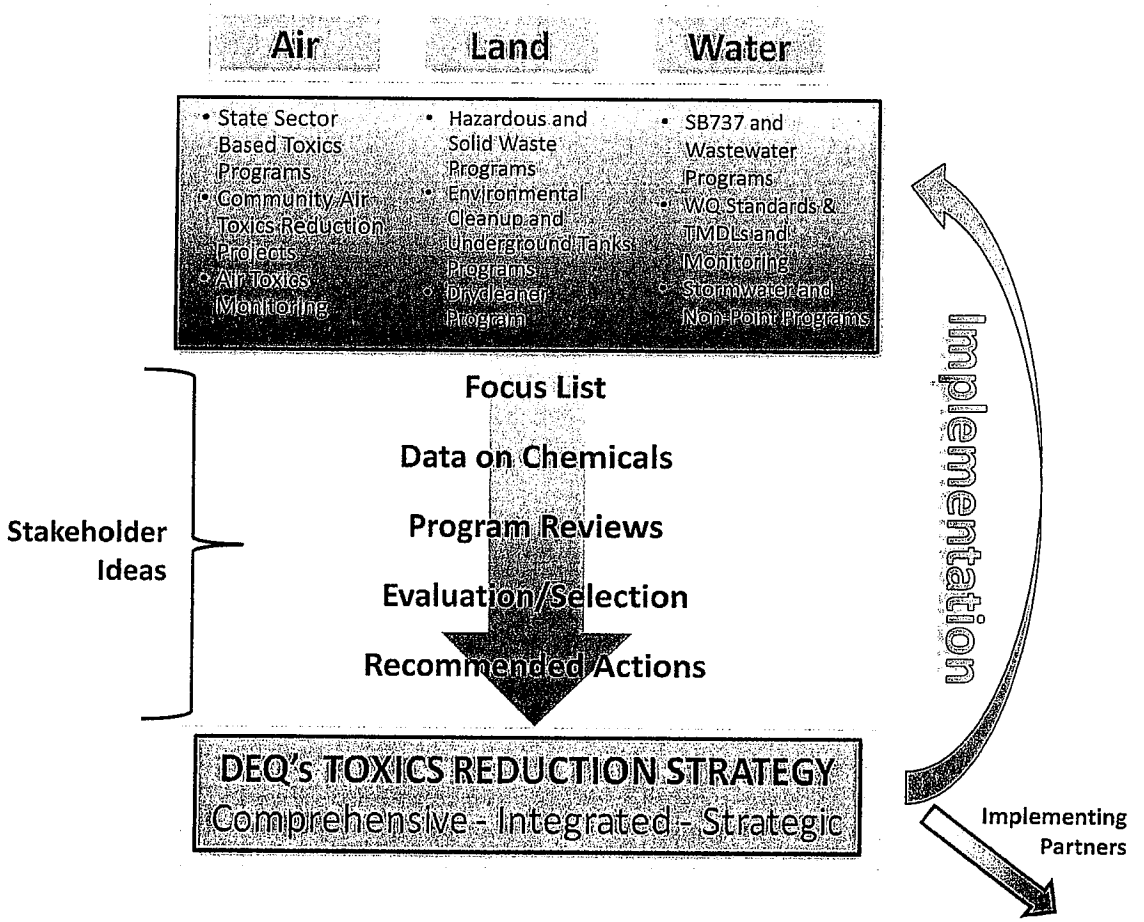

Figure 1: DEQ's Toxics Reduction Strategy

3. The Road to Proposed Rulemaking

Criteria adopted in 2004

Prior to DEQ's current efforts to develop proposed rules addressing human health criteria for toxic pollutants, DEQ developed and adopted rules in 2004. DEQ based these criteria on EPA's recommended criteria at the time, which used an assumed 17.5 grams per day fish consumption rate, which is approximately the amount of fish that fits on a cracker.

Tribes and EPA both expressed concerns about the protectiveness of criteria based on this value would, given the amount of fish that Oregonians consume. While DEQ adopted criteria based on EPA's national recommendations, EPA also pointed out its policy directing states to use local consumption information where available. They both pointed out Pacific Northwest studies documenting the consumption of greater amounts of fish by many populations.

Based on these concerns, DEQ agreed to revisit its water quality standards regulation addressing human health criteria for toxic pollutants.

In June 2010, EPA disapproved the majority of DEQ's human health criteria for toxic pollutants. They concluded the fish consumption rate used would be inadequate to protect Oregonians based on the amount of fish and shellfish they are known to consume. EPA's disapproval caused the majority of the 2004 water quality criteria to no longer be effective, leaving in place the previously effective criteria adopted in the late 1980's. The proposed human health criteria for toxic pollutants will address EPA's disapproval. Without revisions to Oregon's water quality standards to address EPA's disapproval, EPA must develop federal regulations for Oregon addressing their disapproval.

Developing the Proposed Rulemaking

In 2006, DEQ initiated work to relook at fish consumption information and any necessary rule revisions. From that time, DEQ's effort to evaluate fish consumption information and to develop rules has involved many partners, interested stakeholders, and experts. Early in the process, DEQ formed a "Three Governments" partnership with EPA and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). During the first phase of this effort, the three governments co-hosted seven workshops around the state with the objectives of sharing information and discussing stakeholders' views regarding an appropriate fish consumption rate. Simultaneously, DEQ convened a public health expert advisory workgroup and charged them with evaluating the available and relevant fish consumption data and information. The *Human Health Focus Group Report: Oregon Fish and Shellfish Consumption Rate Project* contains the Human Health Focus Group's findings and is posted on DEQ's website. DEQ also convened a Fiscal Impact and Implementation Advisory Committee and requested that the group provide input on the potential fiscal impacts associated with selecting a greater fish consumption rate and evaluate potential implementation approaches DEQ could consider when implementing any revised criteria. The committee wrote a memo to DEQ summarizing the committee's perspectives (FIIAC Memo to the Environmental Quality Commission), which DEQ also posted on its website.

The workshops and input gathered through that process culminated in a joint three government recommendation to DEQ's Environmental Quality Commission (EQC) in October 2008. The three governments recommended DEQ pursue water quality standards revisions based on a 175 grams per day fish consumption rate. This rate represents a ten-fold increase from the fish consumption rate used in the 2004 water quality standards, and equates to approximately 23 eight-ounce meals per month. The EQC agreed with this recommendation and further directed DEQ to:

1. Revise Oregon's toxics criteria for human health based on a fish consumption rate of 175 grams per person per day;
2. Propose rule language that will allow DEQ to implement the standards in National Pollutant Discharge Elimination System (NPDES) permits and other Clean Water Act programs in an environmentally meaningful and cost-effective manner;
3. Propose rule language or develop other implementation strategies to reduce the adverse impacts of toxic substances in Oregon's waters that are the result of non-point source (not via a pipe) discharges or other sources not subject to section 402 of the Clean Water Act;
4. Develop a proposed rule and implementation methods that carefully consider the costs and benefits of the fish consumption rate and the data and scientific analysis already compiled or that is developed as part of the rulemaking proceeding.

In December 2008, DEQ convened a stakeholder advisory Rulemaking Workgroup, comprised of eight members representing municipal and county governments, industry, and environmental organizations, in addition to representatives from EPA and the Confederated Tribes of the Umatilla Indian Reservation. DEQ charged the group to help DEQ develop innovative NPDES implementation options, provide input on rule language development, and identify issues beyond the scope of the rulemaking.

Based on discussions occurring during that year and the interest of the group in discussing pollutant sources that do not receive an NPDES permit, DEQ expanded the workgroup to add five stakeholder advisory members representing nonpoint source interests, including the forestry and agricultural industry. Oregon Departments of Agriculture and Forestry also participated in workgroup discussions.

The stakeholder advisory workgroups met approximately once a month. Through these discussions, DEQ developed a series of issue papers containing DEQ's recommended approach to addressing identified issues, DEQ's accompanying analysis, and documenting the workgroup discussions and concerns, including any issues the stakeholders identified as significant. DEQ published these issue papers on its website as supporting information for the proposed rulemaking.

4. Proposed Rulemaking

Actions Considered

In developing this rulemaking, DEQ considered proposed revisions for many areas of its water quality standards and implementing regulations. DEQ discussed the following areas of potential revisions with its stakeholder advisory workgroups and used the issue papers to evaluate rule revisions or other actions that could be taken.

- Revisions to human health criteria for toxic pollutants;
- Revisions to water quality standards and NPDES permitting rules to address high levels of background pollutants;
- Revisions to water quality standards to address circumstances where facilities may not have treatment technologies available to meet calculated limits in the NPDES permits;
- Revisions to TMDL regulations addressing the inclusion of air or land sources in the development of TMDLs;
- Revisions to water quality standards rules to allow the criteria revisions to be phased in over time or other revisions allowing time specifically for sources to comply;
- Revisions to water quality standards or other rules to address toxic pollutants that may adhere to sediment and transported through soil erosion;
- Revisions to water quality standards and TMDL rules to clarify how actions under the Agriculture Water Quality Management Act and Forest Practices Act meet water quality standards;
- Revisions to water quality standards and Internal Management Directives addressing how DEQ implements antidegradation;
- Revisions to NPDES permitting rules to address indirect discharges of toxic pollutants to municipal wastewater treatment facilities that are currently not included as part of the federal pretreatment program; and

Rules Being Proposed

DEQ is proposing revisions to its water quality standards regulation, as well as targeted changes to its NPDES permitting and TMDL regulations to address how these new standards would be implemented by sources. The proposed rules, if adopted, will be implemented alongside current regulations governing water quality standards and their implementation.

The proposed human health criteria revisions constitute the core of DEQ's proposed rules. DEQ is proposing human health criteria revisions for toxic pollutants based on a fish consumption rate of 175 grams per day. This revision will serve as the basis for NPDES permit limits and other regulatory decisions. Revising the criteria will address EPA's disapproval of DEQ's 2004 criteria and obviate the need for EPA to put in place federal rules for Oregon.

In addition to the proposed criteria revisions, DEQ is proposing new and revised rules addressing the implementation of these revised criteria. In some instances, the proposed rules will be used for more than just the human health criteria. For example, some revisions could also be used to implement criteria that protect fish and other organisms that live in surface waters of the state. These revisions add to or, in some cases, revise current rules governing water quality standards implementation and may be used in a variety of situations. Some rules are intended to be used in situations where the water quality standards are being met; others target situations where water quality standards are not being met and sources may not be able to feasibly meet the necessary pollutant concentrations. The list below provides a brief description of each proposed rule item, including the circumstances in which DEQ or the source may use the regulation.

Intake Credits

DEQ is proposing a new "intake credit" provision in its NPDES regulation. DEQ would use this provision during the development of a facility's NPDES permit where DEQ finds that background pollutants in a discharger's intake water at high levels. As long as the discharger does not increase the mass or concentration of the background pollutants found in its intake water, DEQ would not require the facility to further reduce the pollutants in its discharge. This rule would apply to a relatively narrow set of situations and consequently, may not be widely used. The issue paper titled, "Implementing Water Quality Standards for Toxic Pollutants in Clean Water Act Permits" contains a further description of this rule.

Background Pollutant Allowance

DEQ is proposing a new "Background Pollutant Allowance" provision in its water quality standards regulation. This provision complements the proposed intake credit provision, also addressing the presence of high background pollutant concentrations in a discharger's intake water. DEQ would implement the rule during the development of a facility's NPDES permit when the facility can't avoid increasing the pollutant concentration that comes in from their intake water. In that instance, DEQ would allow the facility to discharge its concentrated effluent as long as the receiving surface water pollutant concentration did not increase by more than a small amount (up to 3%). The provision would prohibit adding more of the pollutant to the surface water than is present in the intake water, would be limited to carcinogenic pollutants, and would constrain the surface water concentration increase to within the EPA-accepted cancer risk level of one in 10,000. DEQ may use this provision for facilities that concentrate process water through the cooling water evaporation, a process that increases the concentration of pollutants already present in their intake water. The issue paper titled, "Implementing Water Quality Standards for Toxic Pollutants in Clean Water Act Permits" contains a further description of this rule.

Variances with Pollutant Reduction Plan Requirement

DEQ is proposing significant revisions to its current water quality standards provision governing variances. DEQ and facilities interested in requesting a variance would use the revised provision when a facility could not immediately meet its permit limits based on water quality standards and where some uncertainty exists regarding when or if the requirements could be met. The revised provisions would allow NPDES permitted facilities to seek a short-term exemption from meeting water quality standards-based limits for a specific pollutant(s) and require a pollutant reduction plan to ensure progress toward meeting the water quality standards in the interim. While DEQ envisions the variance development and approval would most efficiently occur during the development and issuance of an NPDES permit, variance development and approval could also be used at any time during the term of the permit. The issue paper titled, "Implementing Water Quality Standards for Toxic Pollutants in Clean Water Act Permits" contains a further description of this rule.

Revisions to the Water Quality Standards and Total Maximum Daily Load Regulations to Address Nonpoint Sources

DEQ is proposing water quality standards regulation revisions to explain how the mechanisms for forestry and agricultural nonpoint sources work to meet water quality standards and the TMDL load allocations under the Forest Practices Act (FPA) and Agriculture Water Quality Management (AgWQM) Act. FPA rules are meant to be reviewed for their adequacy to meet TMDL load allocation when TMDLs are issued. AgWQM Area plans and rules are reviewed and revised every two years to ensure that the TMDL load allocations are met when area plans and rules are implemented.

DEQ proposes accompanying changes to the Total Maximum Daily Load regulations to clarify DEQ's authority to identify and assign individual load allocations to significant air and land sources in TMDLs. DEQ anticipates additional rulemaking since the mechanism for addressing TMDL allocations through other media programs will need to be defined and described in the administrative rules affecting air and land quality programs.

Other Approaches Available Under Current Regulations

Meeting Water Quality Standards

DEQ currently uses a number of approaches to implement water quality standards in its Clean Water Act programs and to put requirements in place to meet water quality standards. The proposed rules would add to these current approaches and may, in some cases, be used in conjunction with these approaches.

DEQ issues NPDES permits that require dischargers to meet water quality standards. If a discharger can't immediately comply with water quality-based requirements, DEQ can use a compliance schedule as part of the permit to identify enforceable requirements and milestones the permittee must implement to achieve water quality standards-based requirements.

DEQ also develops Total Maximum Daily Loads (TMDLs) to bring impaired waterbodies into compliance with water quality standards and to support beneficial uses.

Further, the Oregon Department of Agriculture implements and revises Agriculture Water Quality Management Plans that provide guidance and rules to land owners and producers and provide an enforceable backstop to resolve water quality issues. The Oregon Department of Forestry implements the state's Forest Practices Act by enforcing management practices and guidelines to operators managing state and private forest lands to prevent water quality issues.

DEQ also has in place a current regulation addressing situations when the lowering of water quality may occur. The current water quality standards require that water quality achieves standards or is better than the water quality standards. No lowering of water quality may occur, except in specified circumstances and after involving the public in a decision as to whether the lowering of water quality is "necessary."

When information indicates that the water quality standards aren't being met

DEQ routinely reviews data from throughout the state to identify waters that don't meet water quality standards. In those instances, Oregon's current water quality standards prohibit further degradation of water quality as part of its antidegradation requirements. In addition, where DEQ identifies waters that don't meet water quality standards, it must prepare a TMDL. The objective of the TMDL is to calculate the assimilative capacity of water bodies, also referred to as the loading capacity. Designated Management Agencies (DMAs) are then responsible for implementing TMDLs for nonpoint sources under their jurisdiction to meet standards. Point sources are responsible for implementing TMDLs through permits. In addition, when DEQ writes permits for discharges to these waters, DEQ puts in place appropriate requirements to support this objective both in advance of the TMDL development, which allocates pollutant loads, and in the writing of permits to reflect the TMDL after it's developed.

When information indicates the water quality standards can't be achieved

DEQ expects that in some circumstances a water body may not be able to achieve water quality standards. In these cases, DEQ may look at the water quality standards and evaluate whether the water body goals are the correct ones. In addition, DEQ may evaluate whether natural or other conditions make it a priority for DEQ conduct further evaluation of relevant scientific information. DEQ followed this approach in its recent proposed rulemaking addressing the iron, manganese, and arsenic criteria, where natural conditions resulted in widespread exceedances of the human health criteria. DEQ can use approaches authorized by the current water quality standards to change the water body goals or uses or to change the criteria based on an evaluation of scientific data and information. DEQ has not frequently made these types of changes to its water quality standards in the past, but recognizes that these types of changes may need to be considered in the future.

5. Implementation Strategies

In addition to the proposed rule revisions, DEQ is developing Internal Management Directives to address additional details regarding the implementation of the proposed rules. DEQ routinely develops these types of documents to provide direction to its staff regarding how the rules should be implemented in its programs. These documents can also provide information that would be helpful to interested parties about how the rules would be implemented, including how DEQ intends to make decisions and the data and information DEQ would use in the rules' implementation.

Based on the rules proposed, DEQ plans to develop or amend current Internal Management Directives to address the following proposed rules:

- **Variances with pollutant reduction plans –** DEQ will describe the types of data and analysis facilities will need to submit, how it will evaluate the information in deciding to approve a request for a variance, the necessary elements of pollutant reduction plans, and how variances would be evaluated and approved in conjunction with the permit issuance process.

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- **Intake credits** – DEQ will describe how it will conduct its evaluation of whether a facility needs water quality-based limits in instances where a facility is eligible for an intake credit.
- **Background pollutant allowances** – DEQ will describe how it will establish water quality-based limits in instances where the background pollutant allowance applies.
- **TMDL implementation** – DEQ will clarify how it will develop and ensure more effective implementation of TMDLs, including the possibility of assigning load allocations to significant land and air sources.

To provide additional information to interested stakeholders regarding how DEQ may implement the proposed rule revisions, DEQ published detailed outlines of the Internal Management Directives (with the exception of intake credits, since DEQ expects the guidance to simply describe calculations) on its website to accompany the proposed rules. Over the next several months, DEQ will continue discussions with interested parties about the implementation of the proposed rules and adding detail to how the proposed rules will be implemented. DEQ will further develop the Internal Management Directives as it works on finalizing the proposed regulations and intends to complete the final draft Internal Management Directives at the time of the Environmental Quality Commission adoption of the regulations, anticipated in June 2011. Through this process, DEQ will develop a clearer picture of how the proposed rules will be implemented.

6. Rule Revisions DEQ is Not Pursuing

DEQ evaluated a number of potential rule revisions that it did not include as part of the proposed rules. The revisions not pursued include:

- Revisions to water quality standards or other rules to address toxic pollutants that may adhere to sediment and transport through soil erosion;
- NPDES permitting rule revisions to address indirect toxic pollutant discharges to municipal wastewater treatment facilities currently not included in the federal pretreatment program;
- Revisions to water quality standards and Internal Management Directives addressing how DEQ implements antidegradation;
- Water quality standards rule revisions to allow the criteria revisions to be phased in over time or other revisions allowing time specifically for sources to comply;

DEQ evaluated several different factors in concluding that it would not pursue rule revisions specifically targeting these areas at this time. These factors included whether federal and state regulations would allow the approach, whether the approach would achieve the desired environmental outcome, whether DEQ has the appropriate authority and resources to implement the revisions, and whether the scientific information currently available supports the approach contemplated. DEQ evaluated these factors with input from the stakeholder advisory committees, EPA, DEQ staff and management, and other state agencies that share regulatory oversight of nonpoint source activities to protect water quality. The issue papers published on DEQ's website in conjunction with the proposed rules describe the specific rule revisions considered, DEQ's evaluation of the potential revisions, and why it recommends not pursuing regulations at this time.

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In several instances, DEQ has actions underway or is proposing actions related to the areas discussed. Specifically, DEQ recommends the following alternative approaches:

- **Toxic pollutants associated with sediments.** DEQ recommends continuing its efforts to implement current water quality standards provisions related to this issue. DEQ will continue its efforts to address excess sedimentation as it assesses and develops TMDLs for waters identified as having sedimentation issues. DEQ will also continue to work with the Departments of Forestry and Agriculture regarding the control of sediment and prevention of erosion to keep sediment-bound mercury (deposited from the air onto the soil) and legacy pollutants (e.g. DDT) out of water bodies. DEQ's Pest Management and Pesticide Stewardship Partnership efforts will continue its focus on keeping current use pesticides out of water bodies through ongoing Integrated Pest Management as well as erosion control.

- **Implementation of Antidegradation for Nonpoint Sources.** DEQ will review the current antidegradation policy and implementation plan and evaluate what actions or measures are needed to implement the antidegradation policy for nonpoint sources. DEQ proposes to add a chapter to its existing internal management directive describing the process or actions the department will take to implement the antidegradation policy for nonpoint sources, including actions that involve working with other state, federal and local agencies.

- **Toxic pollutant discharges to municipal wastewater treatment facilities.** As part of the variance proposed rule language, a POTW must demonstrate that it has the legal authority (such as a sewer use ordinance) to regulate the pollutant for which the variance is sought. In addition, DEQ will continue to support municipalities in implementing the federal pretreatment rules and encourage any POTW efforts to adopt sewer use ordinances or other pollution control practices.

7. Conclusion

The proposed water quality standards revisions represent a significant improvement in the protecting Oregonians. The fish consumption rate used more accurately represents the fish known to be consumed by Oregonians. In addition, this rulemaking will remove the need for EPA to put in place regulations for Oregon. DEQ has worked to incorporate feedback from interested parties for over four years, and will continue to do that with this proposed rulemaking.

DEQ heard from cities and businesses that are likely to be affected by this proposed rulemaking. DEQ performed an evaluation of the existing data and information to try to evaluate the potential impacts of this rule, but in many cases, the data and information are not available to reach solid conclusions. DEQ will put in place regulatory requirements stemming from these rules, once adopted by the Environmental Quality Commission and approved by EPA, as permits are renewed, water quality data collected and evaluated, and TMDL analyses done to further evaluate pollutant sources within watersheds. Some of these actions will occur soon after EQC adoption and EPA approval, others will occur over time as data and information become available. DEQ and sources will have more information

and gain more knowledge through this process in addition to gaining more experience implementing the proposed rules. DEQ may conclude that it would prefer alternative regulatory approaches, which may include proposals discussed during this rulemaking but not pursued, or other regulatory approaches altogether. In this case, DEQ may need to develop further revisions to its water quality standards rules.

Throughout DEQ's development of these proposed rules, DEQ has continued its efforts to prevent toxic pollutants from entering Oregon's environment, recognizing the toxic pollutants do not respect typical boundaries DEQ and others typically set through its programs. Many of DEQ's programs target toxic pollutants that may originate as releases into the air, into the soil and into the waters of the state. DEQ continues to implement these programs and pursue new approaches it finds can be effective as reducing and preventing toxic pollutants in our environment. DEQ also recognizes that where toxic pollutants exist at high levels, the most effective approaches to reducing the pollutants result from comprehensive programs and collaborative efforts. The Toxics Reduction Strategy is one such comprehensive effort that will evaluate many of the proposals brought to the table through this rulemaking process as well as many others that have been suggested that are broader than what DEQ evaluated as part of this process. DEQ expects the recommended actions to build upon not just DEQ's efforts and programs, but to look build upon other groups' efforts to result in the most effective actions.

Agenda for the three hundred and sixtieth regular meeting of the Oregon Environmental Quality Commission

Feb. 16-18, 2011

DEQ headquarters: 811 SW 6th Avenue Portland, 10th floor, room EQC-A

Wednesday, February 16

The commission will hold an executive session and working lunch from noon to 1:30 p.m.

Following the working lunch, the commission will convene a hearing on water quality standards for toxics at 1:30 p.m.

1. Hearing: Water quality standards for toxics
DEQ staff will present a brief introduction of this proposed rulemaking, and the commission will hold a hearing. People wishing to comment will be asked to complete a request-to-speak form, available at the meeting, and limit their testimony on the proposed rules to approximately five minutes.

Please note that the commission and DEQ staff will not respond directly to comments and testimony at this hearing, and all comments presented will be entered into the official rulemaking record. This proposed rulemaking is scheduled for commission action in June 2011.
[Documents]

The commissioners and some DEQ staff will meet for an optional, informal and self-pay dinner at a restaurant in downtown Portland. This dinner is not a formal part of the meeting, but must be noticed under state public meeting law.

Thursday, February 17

The commission will reconvene at 8:30 a.m.

A. Action item: Approval of meeting minutes
The commission will approve, or amend and approve with corrections, minutes from the special Nov. 18, 2010, and regular Dec. 9-10, 2010, commission meetings.
[Documents]

B. Informational and discussion item: Hermiston Foods
DEQ staff will present a report and information regarding odor and nuisance complaints at a site in eastern Oregon belonging to the Hermiston Foods company.
[This staff report is not yet available, but will be posted by February 9]

C. Action item: City of Portland combined sewer overflow stipulated and final amended order
The commission will take action on a recommendation from DEQ staff and representatives from Portland Bureau of Environmental Sciences to approve the city's post-2011 combined sewer overflow facilities plan. This plan is part of the stipulated and final amended order between EQC and Portland regarding combined sewer overflows.
[Staff report and attachments]

D. Action item: Ballast water management rules
The commission will take action on a recommendation from DEQ staff to adopt revised rules for the management of ballast water.
[Staff report and attachments]

E. Informational item: Climate-friendly nurseries in Oregon
Staff from the Oregon Association of Nurseries and Oregon Environmental Council will present

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information on the Climate Friendly Nurseries Program, a collaborative initiative among Oregon nurseries, OEC and Oregon State University for greenhouse gas reductions and more sustainable nursery operations.
[Staff report]

F. Action item: Senate Bill 737 temporary rule proposal
The commission will take action on a recommendation from DEQ staff to temporarily revise plan development requirements for the 52 municipal facilities subject to the provisions of Senate Bill 737. The temporary revisions would remove the requirement for the facilities to create pollutant reduction plans for cholesterol and coprostanol, two pollutants that were present in all facilities' sampled effluent but for which there are there are no feasible pollution prevention activities or cost-effective treatment options and would require an administrative process with little or no environmental benefit.
[Staff report and attachments]

G. Action item: Petition to initiate rulemaking
The commission will take action on a petition from Idaho Power asking the commission to initiate rulemaking for a site-specific temperature criteria for fall Chinook salmon spawning in the Hells Canyon Reach of the Snake River.
[This staff report is not yet available, but will be posted by February 9]

Lunch and executive session
The commission will recess for lunch and an executive session from approximately 12:20 to 1:30 p.m. The session will be held pursuant to ORS 192.660(2)(f), (h).

H. Action item: Rule adoption for the Heat Smart program for residential woodstoves and other solid fuel burning devices
The commission will take action on a recommendation from DEQ staff to adopt rules for the Heat Smart program. DEQ developed the proposed rules in response to the 2009 Oregon Legislature's direction and requirements in Senate Bill 102.
[Staff report and attachments]

I. Action item: Proposed adoption of federal air quality regulations and related permit rules
The commission will take action on a recommendation from DEQ staff to adopt amendments to Oregon's Clean Air Act statutes to align Oregon's rules with recent federal rule updates, a requirement of DEQ's Clean Air Act delegation.
[Staff report and attachments]

J. Action item: 401 Certification Program fee increase
The commission will take action on a recommendation from DEQ staff to adopt rules that increase program fees for the Water Quality Division 401 Certification Program.
[Staff report and attachments not available yet]

The commission will recess at approximately 4:30 p.m.

Friday, February 18

The commission will reconvene at 8 a.m.

K. Informational item: Water quality partnership work between DEQ and Oregon Department of Transportation
Matthew Garrett, ODOT director, will present information about water quality project partnerships between DEQ and the Oregon Department of Transportation.
[Staff report]

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L. Public forum
At 8:15 a.m., the commission will open public forum. This item is scheduled for 60 minutes, but time allotted may be extended or shortened at the commission's discretion. People may present comment in-person or remotely by teleconference call at one of several DEQ offices across the state. No comments may be presented on DEQ rulemakings for which the public comment period has closed. All people wishing to comment must complete request-to-speak forms and the commission may limit times based on the number of people wishing to comment.

Office locations for remote comment are not yet set, and will be posted online by February 9.

M. Action item: Magar contested case
The commission will take action on a contested case related to water pollution control facility permit violations.
[Staff report, attachments, audio]

N. Informational item: Supplemental environmental projects
DEQ staff will present information on supplemental environmental projects, which allow people who must pay a civil penalty for violating environmental laws to apply some of the penalty fees toward local environmental improvement projects and reduce the fees paid to the state, up to 80 percent of the total penalty owed.
[Staff report and attachments]

O. Informational item: Budget and legislative updates
DEQ staff will present an update on DEQ's budget development process, legislation and other related topics.
[Staff report and attachment]

P. Informational and discussion item: DEQ key performance measures
Director Pedersen will present, and offer for commission discussion, a report on DEQ's annual key performance measures. This presentation is in preparation for DEQ's presentation to the Joint Ways and Means Committee of the Oregon Legislature.
[This staff report is not yet available, but will be posted by Thursday, February 10]

Lunch
The commission will recess for an informal lunch from approximately 12:15 to 1:15 p.m.

Q. Director's dialogue
Director Pedersen will present updates and information on DEQ projects and activities not otherwise presented during the course of the meeting.
[This staff report is not yet available, but will be posted by Thursday, February 10]

R. Action item: Director's financial transactions for 2010
The commission will take action on a recommendation from DEQ staff to approve Director Pedersen's financial transactions for 2010. The annual review of the director's transactions is required by state and agency accounting rules.
[Staff report and attachments]

S. Commissioner reports
The commissioners may present updates on any environmental issues or their other activities not discussed during the meeting.

The commission will adjourn at approximately 5 p.m.

2011 EQC meeting dates and locations
April 21-22: Western Region, location to be determined
June 16-17: Eastern Region, location to be determined
August 18-19: Western Region, location to be determined

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October 20-21: Northwest Region, location to be determined
December 15-16: Portland

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PLANNING DEPARTMENT

"Implementation Ready" TMDLs for Reducing Toxic Pollutants in Oregon Waters from Nonpoint Sources

Draft Issue Paper

I. Introduction

A. Context

The Environmental Quality Commission directed the department to review existing rules and implementation strategies to identify gaps and propose strategies including rule changes that would reduce toxics in Oregon waters that come from nonpoint sources and other sources not regulated by permits under section 402 of the federal Clean Water Act.

The department is considering a number of items for inclusion in the toxics standards rulemaking package. One of the methods being considered is for the department to develop Total Maximum Daily Loads (TMDLs) with other partners that better describes the sources of the pollutant and make the TMDL easier to implement for reductions of the pollutant.

TMDLs are watershed scale water quality calculations and pollutant source analyses that determine the amounts of pollution that streams could receive and still meet applicable water quality standards. A TMDL identifies and quantifies sources of pollution causing water quality standard violations. The quantification is done by estimating the pollutant load instream and from the sources. These loads are then used to determine the amount of reductions needed to meet water quality standards. A TMDL is developed, including load reductions scenarios, are determined in collaboration with stakeholders. A TMDL is a tool to bring impaired waterbodies into compliance with water quality standards and support beneficial uses.

B. Purpose, Why we are doing this now

The purpose of this issue paper is to determine whether changes to current TMDL development and implementation procedures would further the goal of reducing and preventing toxic pollutants in waters of the state. As part of the current review of Oregon's human health toxics criteria, the department is working with a stakeholder group to develop reduction strategies for toxics from non-NPDES sources. The department will use these strategies to develop recommendations for a rulemaking package to accomplish the directive from EQC.

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II. Background

A. History

Under the Clean Water Act (CFR 130.7) and state statute (ORS 468), the agency is authorized to develop, implement, and enforce TMDLs. TMDLs have been developed and implemented in Oregon since the late 1980's. Oregon's TMDL rule (OAR 340-042-0025) was adopted by the EQC in 2002.

B. Problem Description

In Oregon, there are toxic chemicals on 303(d) list for certain segments of waterbodies due to water quality standards exceedances. In addition, concerns about the level and variety of toxics in Oregon waters have been highlighted in various studies by governmental agencies, such as USGS and the agency. These concerns have also been raised by citizens, environmental groups, as well as the EQC. Toxic pollutants come from various point sources and nonpoint sources. Toxic pollutants from nonpoint sources could include both current use and legacy sources. Examples of these sources include pesticides, metals, fertilizers, urban stormwater, and others. Some toxics may be applied intentionally, like pesticides, while other could be unintentionally via air deposition. In either case, the toxics are transported to water bodies in runoff or attached to sediment.

There are many partners that have been actively working on pollution control associated with agricultural and forestry activities. These partners include individual land owners, Departments of Agriculture, Forestry, and State Lands, various Soil and Water Conservation Districts, cities, counties, federal land management agencies, and Natural Resource Conservation Service. Despite all the efforts made by these partners to reducing the amount of toxics entering waterbodies, they are still not meeting water quality standards for toxic pollutants.

Our partners such as ODA, ODF, federal land management agencies and municipalities have programs in place to address sources of pollution to meet water quality standards and TMDL load allocations. Currently, most of the TMDLs are developed at a basin or subbasin levels, and address multiple pollutants and are focused on calculating the instream pollutant budget also referred to as the loading capacity. The main criticism for current TMDL approach is that usually TMDLs do not provide enough detailed information about sources of the pollutant and TMDL implementation for stakeholders to take specific management actions. The current TMDL approach can be improved to address toxic reductions more effectively and efficiently in waters of the state with better source identification and information for TMDL implementation included in the TMDL.

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The shortcomings indentified in current TMDLs are:

- Large geographic scope and lack of spatial detail: It is difficult for stakeholders and DMAs to develop and implement water quality improvement strategies based on the agency's basin wide TMDLs.
- Lack of clarity around air and land sources: It is not clear in rule if air deposition and land sources could be required to meet waste load or load allocations.
- Lack of specific timeline and measurable milestones: Without having an implementation schedule that includes measurable milestones, it is difficult to assess if there are incremental improvements in water quality or if adaptive management measures may be necessary.
- Lack of detail in reduction strategies for nonpoint sources: DMAs and land owners find it difficult to know what on the ground actions are needed to meet TMDL pollutant reduction goals.

C. Oregon's TMDL Program and Toxics TMDLs

The agency has developed and issued TMDLs for toxic pollutants and EPA has approved them. The pollutants for these TMDL were mainly legacy pesticides and heavy metals. The agency has also developed guidance to DMAs for TMDL implementation (http://www.deq.state.or.us/WQ/TMDLs/docs/impl/07wq004tmdlimplplan.pdf). This guidance includes directions to the agency staff for providing technical assistance to DMAs for development of TMDL Implementation Plans.

When rivers or streams are listed as impaired, states are required to develop TMDL that defines how much of a pollutant a waterbody can receive and still meet water quality standards. The complete federal TMDL regulation is provided in Attachment C.

In addition, EPA provides a number of guidance documents for TMDL development and watershed planning for implementation. (Available at: http://www.epa.gov/owow/TMDL/guidance.html)

The complete TMDL rule is provided in Attachment B.

III. Addressing existing issues and gaps with TMDLs through "Implementation Ready" TMDLs

The agency is evaluating different approaches for developing and implementing TMDLs. These approaches are based on ideas raised within the agency and by stakeholders. For any changes adopted, the agency must provide guidance as to how the changes are put into practice while meeting Oregon's requirement to have TMDL implementation plans. To ensure consistency across

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the state, the guidance needs to ensure the changes are understood and followed by the agency's regional staff.

A. TMDL Development

1. Spatial Scale and sources of pollutants

Due in part to resource constraints, TMDLs are currently developed at large spatial scales, such as USGS 6-digit or 8-digit HUCs. Source assessment is required by the TMDL regulations, but the level of detail is not specified. The large spatial scale and lack of detail in source assessment in current TMDLs do not provide the information necessary to facilitate collaboration among stakeholders, DMAs, and the agency to identify specific options for implementation.

Applicability/Scope

This solution would be applied statewide, beginning with basins where TMDLs will be developed in the near future.

DEQ Recommendation

Develop TMDLs at a manageable spatial scale and conduct detailed source assessment in addition to assigning a single load allocation that applies to all nonpoint sources. Work with stakeholders and DMAs to provide information for source assessment, confirm analysis results, determine implementation timelines and strategies, and allocate responsibilities.

Develop Internal Management Directive (IMD) for "Implementation Ready" TMDLs that provides guidance on how to develop TMDLs with stakeholders and DMAs. The IMD needs to include guidance on how to develop TMDLs:

- Involve stakeholders in the TMDL process at all levels [OAR 340-042-0050(1)]
- Select manageable spatial scale [OAR340-042-0040(2)]
- Conduct source assessment [OAR 340-042-0040(4)(f)]

Corresponding paragraphs and subsections of OAR Division 42 TMDL rule are indicated for the items that will be included in the Implementation-Ready TMDL IMD.

Policy objective

Identify sources of toxic pollutants to Oregon waters in order to prevent further impairment and move toward attainment of water quality standards.

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Policy evaluation

If this strategy is implemented, TMDLs would provide DMAs with the direction needed to develop implementation plans with specificity as to where and when management measures and restoration projects will be implemented.

Advantages and disadvantages

Conducting a finer scale source analyses for TMDLs will allow DEQ to provide guidance to DMAs as to what they need to do to achieve TMDL goals. It will be a significant added workload for DEQ to develop TMDLs. Providing added guidance through a development of IMD will also require additional resources.

Summary of RWG discussion and views ***(RWG, please provide additional comments if your view is not reflected in this section)***

The rulemaking workgroup has discussed this issue at several meetings. In addition to the workgroup meetings, the department met with individual members outside of the meeting for more in-depth discussions.

- The workgroup members have expressed concerns about lack of adequate funding for the agency and other agencies to support this work. The agency explained that it will prioritize available resources.
- There has been both support and concerns about the agency's intent to identify specific practices for implementing TMDLs. The agency explained the need and importance of agency partners and local stakeholders' involvement.
- Some work group members questioned the department's authority to regulate agricultural practices and forest operations. The agency shared some legal documents that clarified the agency's authority around forestry, and explained its regulatory authority for other sources.

Authority and precedence

The department has authority to develop "Implementation-Ready" TMDLs under Oregon's TMDL rule, OAR 340-042-0025 to 0080. OAR 340-042-0040(4) specifies elements that must be included in a TMDL. OAR 340-042-0040(4)(l) Water Quality Management Plan (WQMP) lists items that must be addressed in the WQMP in paragraphs (A) through (O).

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2. Air and Land sources

Although the department has authority to do so already, its ability to identifying significant air and land sources and assign Waste Load Allocations (WLAs) or and Load Allocations (LA) for air and land sources is not explicit in the Division 42 TMDL rule.

Applicability/Scope

This solution will be applied statewide, beginning with basins where TMDLs will be developed in the near future.

DEQ Recommendation

Revise rule to explicitly allow the department to assign an individual load allocation to significant air and land sources in TMDLs.

Proposed rule language to be added to OAR 340-42-0040 (4)
(g) Wasteload allocations. This element determines the portions of the receiving water's loading capacity that are allocated to existing point sources of pollution, including all point source discharges regulated under the Federal Water Pollution Control Act Section 402 (33 USC Section 1342).

340-042-0040(h) Load allocations. This element determines the portions of the receiving water's loading capacity that are allocated to existing nonpoint sources, including runoff, deposition, soil contamination and groundwater discharges, or to background sources. Load allocations are best estimates of loading, and may range from reasonably accurate estimates to gross allotments depending on the availability of data and appropriate techniques for predicting loading. Whenever reasonably feasible, natural background, long-range transport and anthropogenic nonpoint source loads will be distinguished from each other.

Rule objective

Assign load allocations to require pollution control in order to prevent further impairment and move toward attainment of water quality standards

Rule evaluation

If this strategy is implemented, the department will determine load allocations for air and land sources in TMDLs, and work with the Air Quality and Land Quality Divisions to meet those allocations.

Advantages and disadvantages

Assigning waste load allocations to significant air and land sources could reduce toxic pollution in Oregon's waters through reduction in air deposit and runoff. This work may

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require additional resources in both the Water Quality and Air Quality Divisions. Providing added guidance through a development of IMD will also require additional resources. Air Quality Division may subsequently need to modify air rules to be able to fully implement the waste load allocations when air sources are identified as a source in TMDLs.

Summary of RWG discussion and views ***(RWG, please provide additional comments if your view is not reflected in this section)***

The rulemaking workgroup has discussed this issue at several meetings.

- The workgroup members have expressed the importance of addressing air sources and their support for being explicit about the department's authority to regulate air sources through TMDLs. The department explained to the workgroup that "deposition" in proposed rule language is intended to mean all types of deposition including air deposition.
- Other members have expressed their concerns about lack of detail such as the scope and also how the department will regulate air sources to meet load allocations. (See Div 41 and 42 Revision Issue Paper for details)
- Some members of the workgroup raised the possibility that if air sources are identified as a source in TMDLs, the air sources may be forced to fund air modeling associated with TMDLs to differentiate nearby depositions and long range transport.

Authority and precedence

The department already has authority to assign load allocations to land and air sources. [OAR340-042-0040(6)] Additional rulemaking in air rules may be needed for the department to fully implement the waste load allocation when air sources are identified as a source in TMDLs. It should be noted that the department made a policy decision to limit the scope of the toxics water quality standards rulemaking to divisions under water program. The actual regulatory mechanism for addressing TMDL allocations through other media programs still needs to be defined and described. The approach described above is one of potential strategies that the department will consider during Toxics Reduction Strategy development.

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3. Timelines and milestones

The department is required to include timeline and schedule in Water Quality Management Plans (WQMPs) for implementing the TMDLs. The timeline and associated milestones set by the department in TMDLs are currently not specific.

Applicability/Scope

This solution will be applied statewide, beginning with basins where TMDLs will be developed in the near future.

DEQ Recommendation

Provide guidance through IMD and require TMDLs to have specific timelines and associated milestones in TMDLs. The guidance should provide ways to meet timelines and clarify what regulatory authority and actions that the department can take if timelines and milestones are not met.

- Set specific implementation and water quality milestones [OAR340-042-0040(4)(I)(D)]

Corresponding paragraphs and subsections of OAR Division 42 TMDL rule are indicated for the items that will be included in the Implementation-Ready TMDL IMD.

Policy objective

Set more specific timeline and milestones that measure implementation efforts and track progress toward attainment of water quality standards.

Policy evaluation

If this strategy is implemented, the department will include in TMDLs more specific timeline and associated milestones for implementation efforts and instream water quality goals.

Advantages and disadvantages

Having specific timelines and associated milestones will clarify the department's expectations and allow DMAs and other sources within a TMDL basin to plan their activities and measure progress. The timelines and milestones would: Increase accountability of DMAs and the department for addressing water quality impairments; Set priority areas for implementation; Provide for more transparency in the implementation process; Allow for adaptation of implementation approach given interim progress reports on whether milestones are being met; Promotes the ownership of the implementation process by DMAs and stakeholders. Development of timelines and milestones would require additional resources. Development of IMD to provide additional guidance will also require additional resources.

00003437

Summary of RWG discussion and views

The rulemaking workgroup discussed the need for TMDLs to provide information to facilitate implementation, but not specifically about timelines.

- Some of the stakeholders compared the requirements for point sources under permits and for nonpoint sources. They expressed the need for nonpoint sources to have more specific schedule for compliance.

Authority and precedence

The department currently has authority to set timelines and milestones in TMDLs. [OAR340-042-0040(4)(l)(D) and (F)]

4. Reasonable assurance

The rationale the department provides in current WQMPs does not ensure that TMDLs will be implemented.

Applicability/Scope

This solution will be applied statewide, beginning with basins where TMDLs will be developed in the near future.

DEQ Recommendation

Develop Internal Management Directive (IMD) for "Implementation Ready" TMDLs and set specific timelines and interim milestones. (See item 3 Timelines and Milestones)

Policy objective

Provide assurance that toxic pollutants will be reduced in order to prevent further impairment and move toward attainment of water quality standards.

Policy evaluation

If this strategy is implemented, timelines and milestones could be used to quantify progress in meeting load reductions and interim assessments in the improvement or changes in water quality. It will therefore provide better assurance that TMDLs will be implemented and water quality goals will be met.

Advantages and disadvantages

Changing the way TMDLs are developed will require additional resources, however, including description on how the department will ensure that TMDLs will be implemented in the TMDL documents does not require significant resources.

Summary of RWG discussion and views ***(RWG, please provide additional comments if your view is not reflected in this section)***

00003438

The rulemaking workgroup has not had a focused discussion around providing reasonable assurance in TMDLs.

- Some members have expressed the need for nonpoint sources to have more specific targets to measure progress and compliance with TMDL load allocations.

Authority and precedence

The department has authority to develop "Implementation-Ready" TMDLs under Oregon's TMDL rule, OAR 340-042-0025 to 0080. OAR 340-042-0040(4) specifies elements that must be included in a TMDL. OAR 340-042-0040(4)(l) Water Quality Management Plan (WQMP) lists items that must be addressed in the WQMP in paragraphs (A) through (O).

[illegible] TMDL Implementation

1. Unclear TMDL goals for Agriculture and Forestry (example: 26.7% Mercury load reduction in Mainstem Willamette):

The process and standards to evaluate adequacy of regulations and programs for implementing TMDLs are not clear for agriculture and forestry land sources. Clarification is needed for the department's process for evaluating Best Management Practices (BMP) effectiveness in meeting TMDL load allocations, as well as explicit steps for elevating issues to EQC, in cases where there are disagreements between agencies.

Applicability/Scope

This solution will be applied statewide, beginning with basins where TMDLs will be developed in the near future.

DEQ Recommendation

Develop Internal Management Directive (IMD) for "Implementation Ready" TMDLs that provides guidance on how to develop TMDLs with stakeholders and DMAs to facilitate implementation. In the IMD, describe a process for evaluating the adequacy of ODA's and ODF's regulations and programs for achieving TMDL load allocations. Work with ODA and ODF to decide how they should be involved in the evaluation process. Describe in the IMD what information needs to be included in TMDLs in order to use surrogate measures effectively.

- Select acceptable practices and conditions [OAR340-042-0040(5)(b), (6)]

00003439

- Determine specific amount of practices needed to achieve TMDL goals [OAR340-042-0040(4)(l)(C), (5)(b)]
- Develop plans for implementation effectiveness monitoring and tracking [OAR 340-042-0040(4)(l)(K)]
- Ensure BMP and implementation strategy effectiveness [OAR 340-042-0040(4)(l)(K), (5)(b)]
- Estimate costs associated with technical assistance and implementation [OAR 340-042-0040(4)(l)(N)]
- Determine adequacy of DMA implementation strategies for meeting load allocations [OAR 340-042-0040(4)(l)(E)]
- Select implementation strategy that will provide reasonable assurance for achieving water quality goals [OAR 340-042-0040(4)(l)(J), (5)(b)]
- Facilitate stakeholders taking ownership of the TMDL implementation [OAR 340-042-0040(4)(l)(L) and (M)]

Corresponding paragraphs and subsections of OAR Division 42 TMDL rule are indicated for the items that will be included in the Implementation-Ready TMDL IMD.

Policy objective

Clarify the process and standards for evaluating the adequacy of forestry and agriculture regulations and programs in meeting TMDL load allocations.

Policy evaluation

Having a clear process for evaluating adequacy of the Oregon Forest Practices Act (FPA) and Agriculture Water Quality Management Area Plan (AgWQMAP) as well as a process for issue resolution should improve the efficacy of implementation plans and allow for better allocation o f limited resources.

Advantages and disadvantages

Having a clear process allows consistent and timely implementation of TMDLs, thus could ensure reduction of toxics in Oregon's waters. Currently, it is difficult to determine how much additional resources are needed to evaluate adequacy of ODA and ODF's regulations and programs.

Summary of RWG discussion and views ***(RWG, please provide additional comments if your view is not reflected in this section)***

The rulemaking workgroup has had several lengthy discussions about working with other regulatory agencies on TMDL implementation to reduce toxics.

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- Many workgroup members are supportive of the collaborative relationships the department has with ODA and ODF and expressed those views.
- Some have expressed concerns about the department making unilateral decisions without enough local input. The department confirmed its support for collaboration and intent to continue working with both agencies during TMDL development and implementation.

Authority and precedence

The processes for resolving issues between the EQC, ODA, and the Board of Forestry are explicitly described in statutes. (ORSs 468, 527, 568, and 561) There is no clear process for the department, however, for elevating issues to EQC.

2. Lack of clear goals for urban and rural stormwater management

There currently exists no clear process for addressing urban and rural residential stormwater. Specifically, there is not a process to address National Pollutant Discharge Elimination System (NPDES) permitted and NPS stormwater sources in TMDL development. Furthermore, the expectations for both point and nonpoint sources with respect to NPDES stormwater permits needs to be clarified for DMAs.

Applicability/Scope

This solution will be applied statewide, beginning with basins where TMDLs will be developed in the near future.

DEQ Recommendation

"Implementation Ready" TMDL guidance will provide specific information about BMPs for a comprehensive stormwater management program. The information will include the surrogates (if nescesary) for the WLA and LA.

Policy objective

Clarify the process and standards for evaluating the adequacy of both permitted and NPS urban and rural residential stormwater management plans designed to meet TMDL LAs and WLAs.

Policy evaluation

Advantages and disadvantages

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By providing a clear process and sufficient information to stormwater DMAs will improve the development and implement TMDL implementation plans relating to stormwater.

*Summary of RWG discussion and views**(RWG, please provide additional comments if your view is not reflected in this section)***

The rulemaking workgroup has had several lengthy discussions about how nonpoint sources could support the effort to reduce toxics. The discussions during workgroup meetings have mainly been focused around forestry and agriculture.

- The department has received some written comments about urban stormwater being an important issue.
- Some stakeholders also expressed their concern that the agency's efforts have been focused on agriculture and forestry when toxics in urban stormwater is an important issue. The agency explained that its authority to regulate urban DMAs is clear in rules compared to agriculture and forestry.

Authority and precedence

The department has authority to regulate local governments and entities for urban and rural residential stormwater under Oregon TMDL rules.

3. BMP effectiveness evaluation for meeting TMDLs

Currently, the department does not have standards for evaluating effectiveness of BMPs to meet TMDL allocations. Stakeholders have expressed concerns that without adequate evaluation of BMP effectiveness and monitoring requirements, it is not possible to ensure TMDL compliance for nonpoint sources.

Applicability/Scope

This solution would be applied statewide, beginning with basins where TMDLs will be developed in the near future.

DEQ Recommendation

Develop IMD for "Implementation Ready" TMDLs and provide guidance on how to select and adjust design specifications, selection of BMPs, and surrogate measures in TMDLs over time. Initial actions outlined in the implementation plan should be altered as needed based on more current measures of water quality. For instance, if the waters are attaining water quality standards before full implementation of load reductions, it may not be necessary to implement any more practices.

00003442

Policy objective

Ensure implementation activities are effective to reduce pollutants and achieve water quality standards.

Policy evaluation

By clarifying how BMPs will be evaluated for their sufficiency to meet TMDL LA and WQS, there is better assurance that BMPs, when selected for implementation of TMDLs, will contribute to reducing pollution.

Advantages and disadvantages

Working with other state, federal, and local entities to determine the effectiveness of BMPs and design specifications would require addition resources for the department and other participating agencies. Providing added guidance through a development of IMD will also require additional resources.

Summary of RWG discussion and views ***(RWG, please provide additional comments if your view is not reflected in this section)***

The rulemaking workgroup has had some discussions on BMP effectiveness. ODA and ODF provided information about their monitoring programs.

- Some workgroup members have expressed the need for more robust BMP effectiveness monitoring for nonpoint sources including urban stormwater.

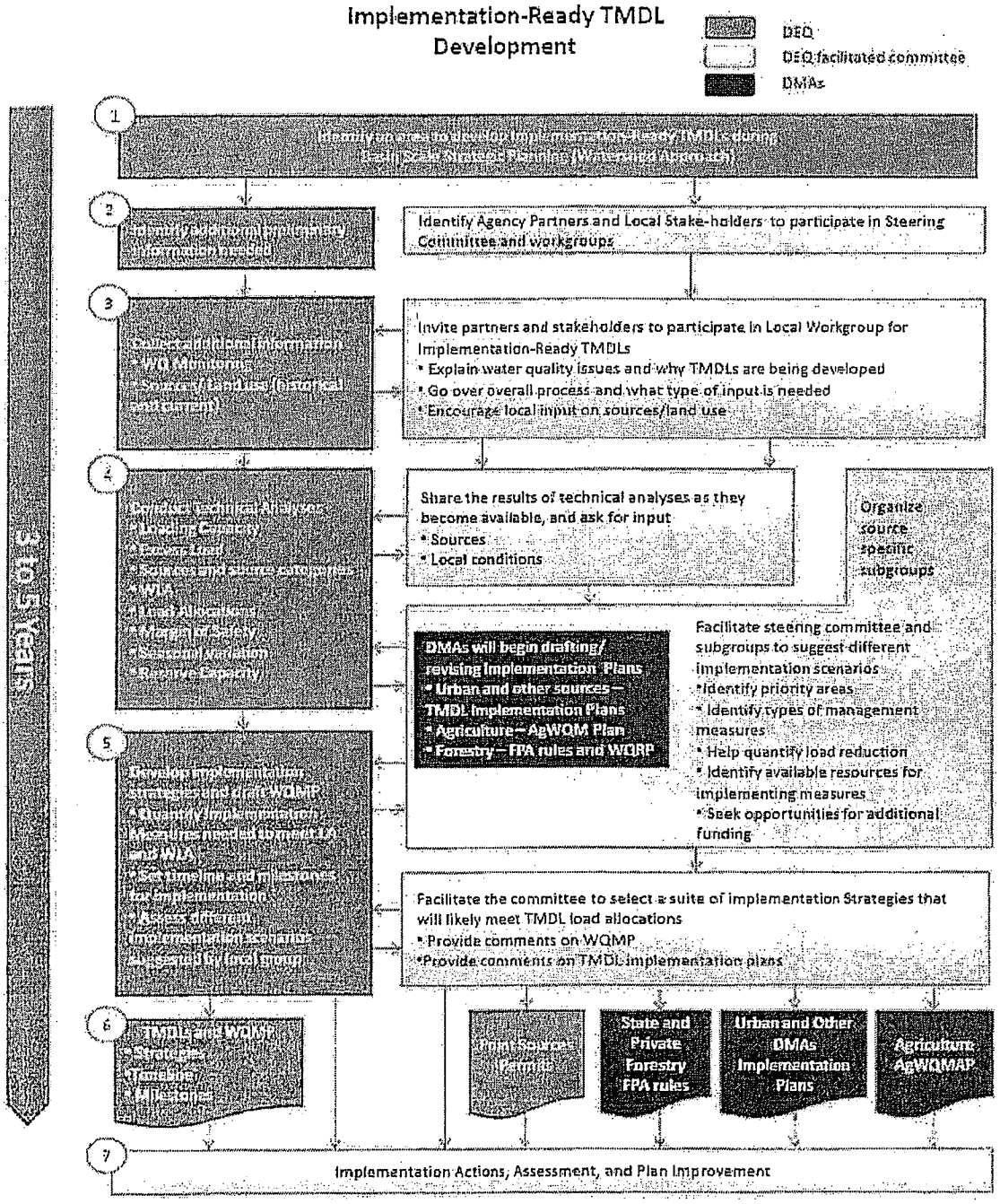
Authority and precedence

The department already has authority to specify actions that are needed to meet TMDL load allocations under the TMDL rule. [OAR 340-042-0040(5)(b)]

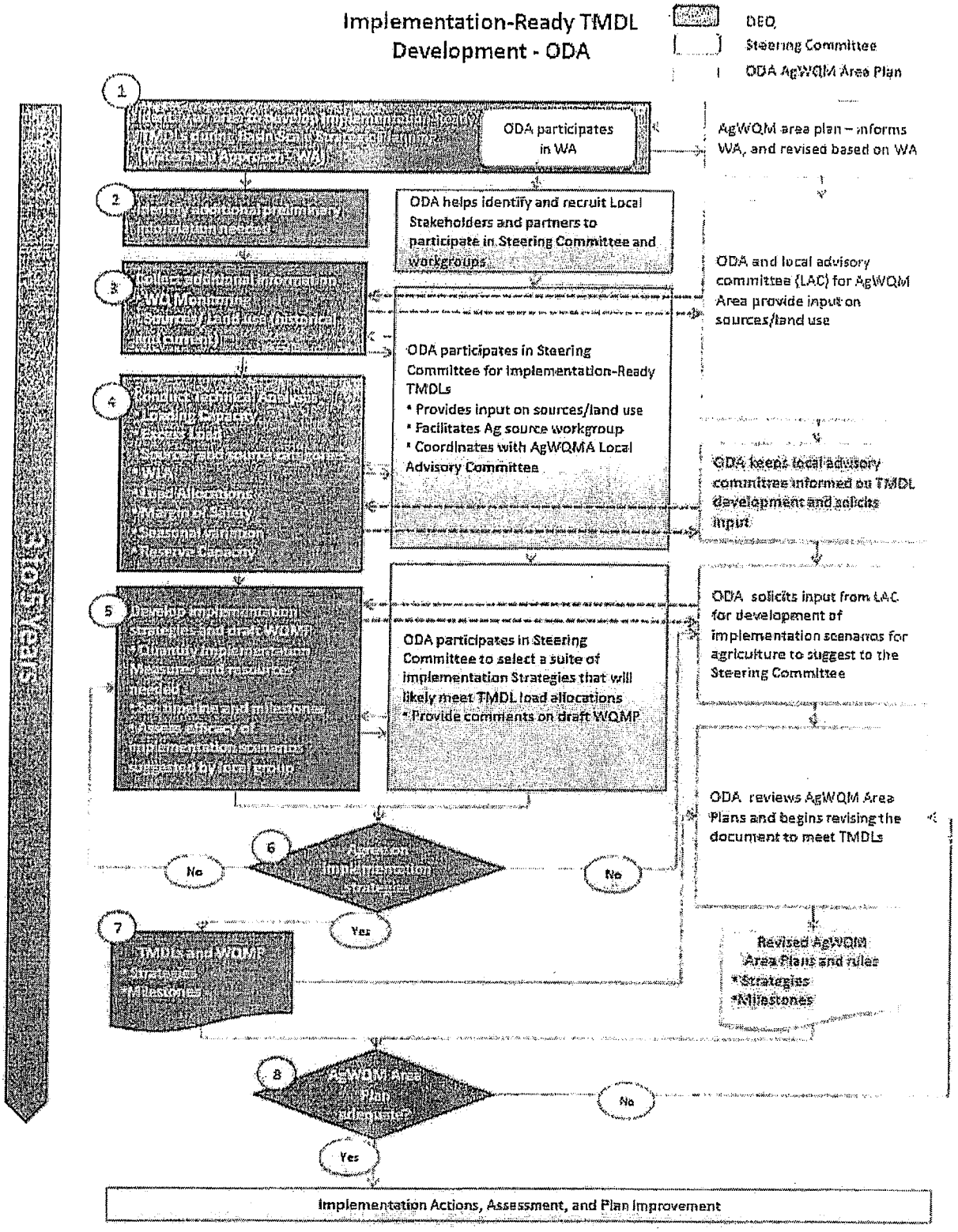
00003443

Attachment A

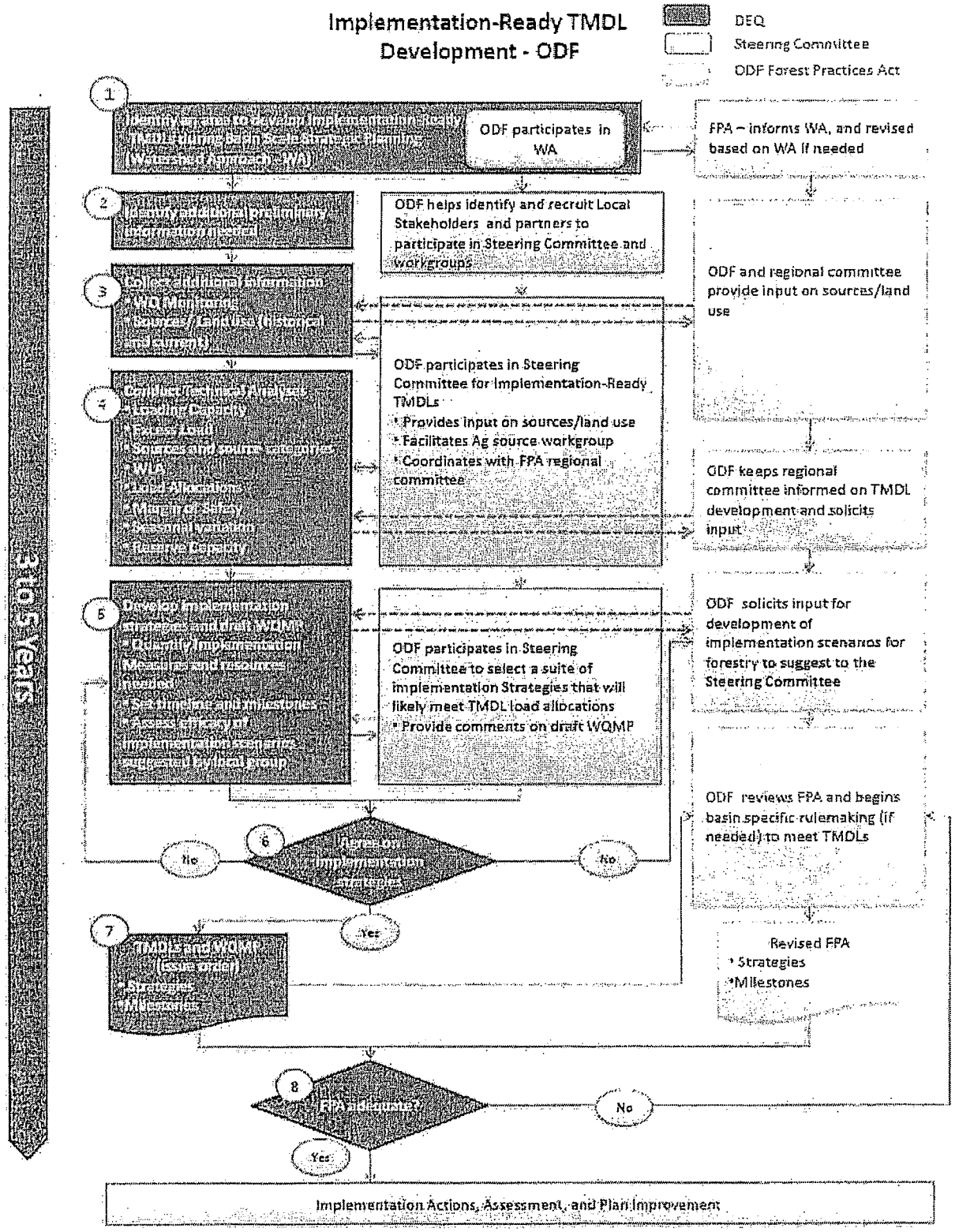
Draft TMDL related flow charts



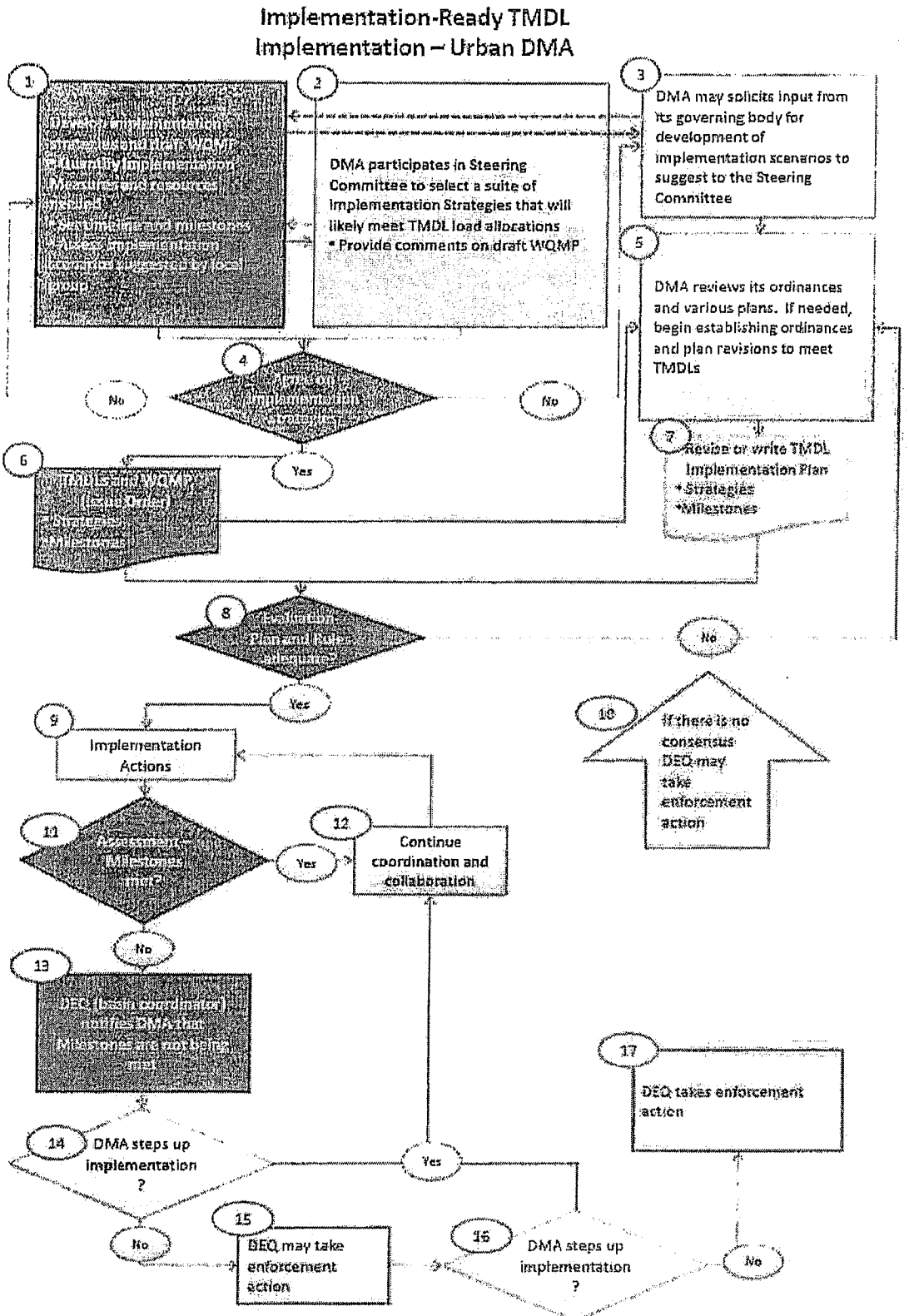
00003444


Implementation-Ready TMDL Development - ODA
DEQ
Steering Committee
ODA AgWQM Area Plan
1
ODA participates in WA
AgWQM area plan – informs WA, and revised based on WA
2
ODA helps identify and recruit Local Stakeholders and partners to participate in Steering Committee and workgroups
3
ODA and local advisory committee (LAC) for AgWQM Area provide input on sources/land use
ODA participates in Steering Committee for implementation-Ready TMDLs
* Provides input on sources/land use
* Facilitates Ag source workgroup
* Coordinates with AgWQMA Local Advisory Committee
4
ODA keeps local advisory committee informed on TMDL development and solicits input
5
ODA participates in Steering Committee to select a suite of implementation Strategies that will likely meet TMDL load allocations
* Provide comments on draft WQMP
ODA solicits input from LAC for development of implementation scenarios for agriculture to suggest to the Steering Committee
6
No
No
Yes
ODA reviews AgWQM Area Plans and begins revising the document to meet TMDLs
7
Revised AgWQM Area Plans and rules
*Strategies
*Milestones
8
No
Yes
Implementation Actions, Assessment, and Plan Improvement

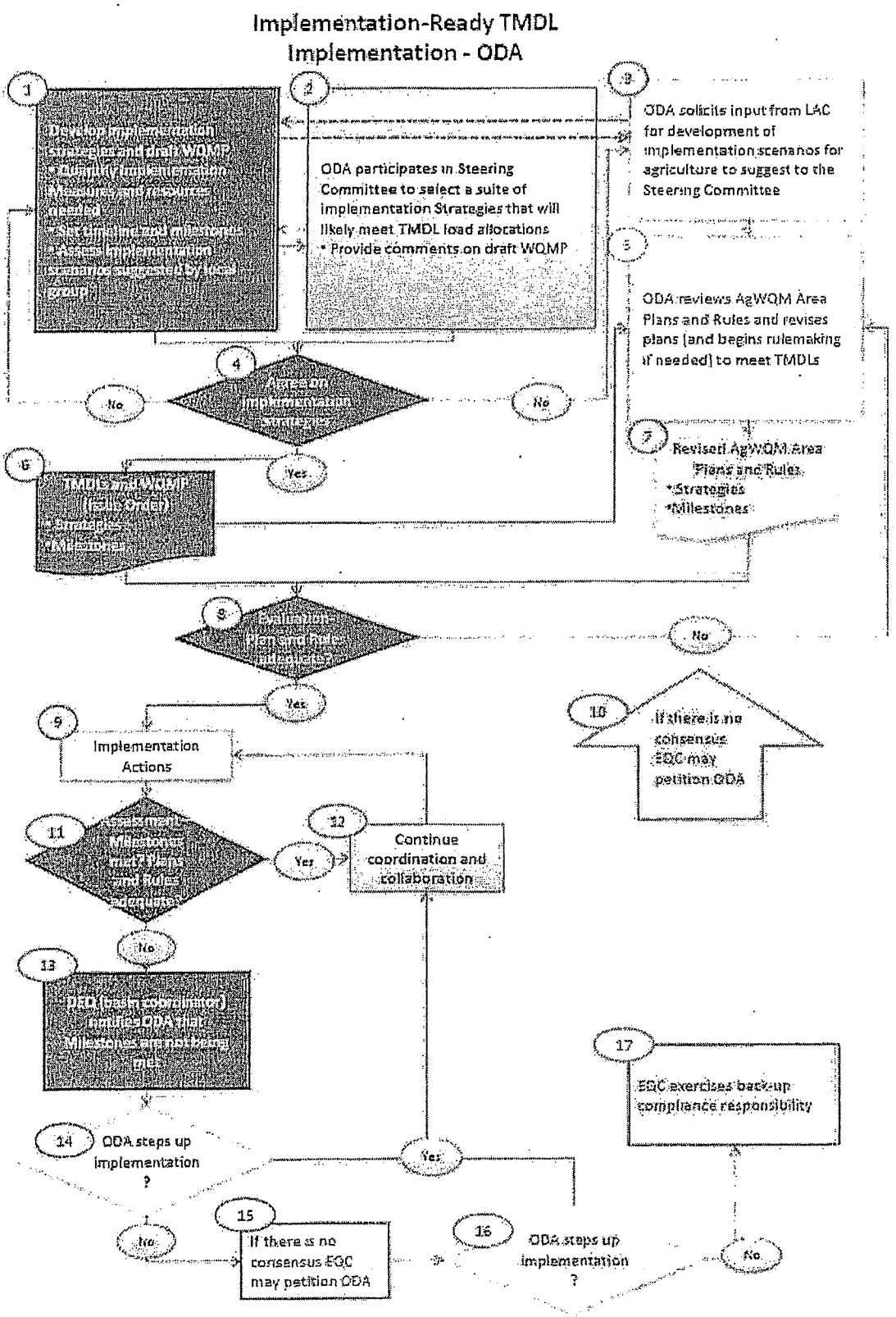
00003445


Implementation-Ready TMDL Development - ODF
DEQ
Steering Committee
ODF Forest Practices Act
1
ODF participates in WA
FPA – informs WA, and revised based on WA if needed
2
ODF helps identify and recruit Local Stakeholders and partners to participate in Steering Committee and workgroups
3
ODF and regional committee provide input on sources/land use
4
ODF participates in Steering Committee for Implementation-Ready TMDLs
• Provides input on sources/land use
• Facilitates Ag source workgroup
• Coordinates with FPA regional committee
ODF keeps regional committee informed on TMDL development and solicits input
5
ODF solicits input for development of implementation scenarios for forestry to suggest to the Steering Committee
ODF participates in Steering Committee to select a suite of implementation Strategies that will likely meet TMDL load allocations
• Provide comments on draft WQMP
ODF reviews FPA and begins basin specific rulemaking (if needed) to meet TMDLs
6
No
No
Yes
7
Revised FPA
• Strategies
• Milestones
8
No
Yes
Implementation Actions, Assessment, and Plan Improvement
5 to 15 Years

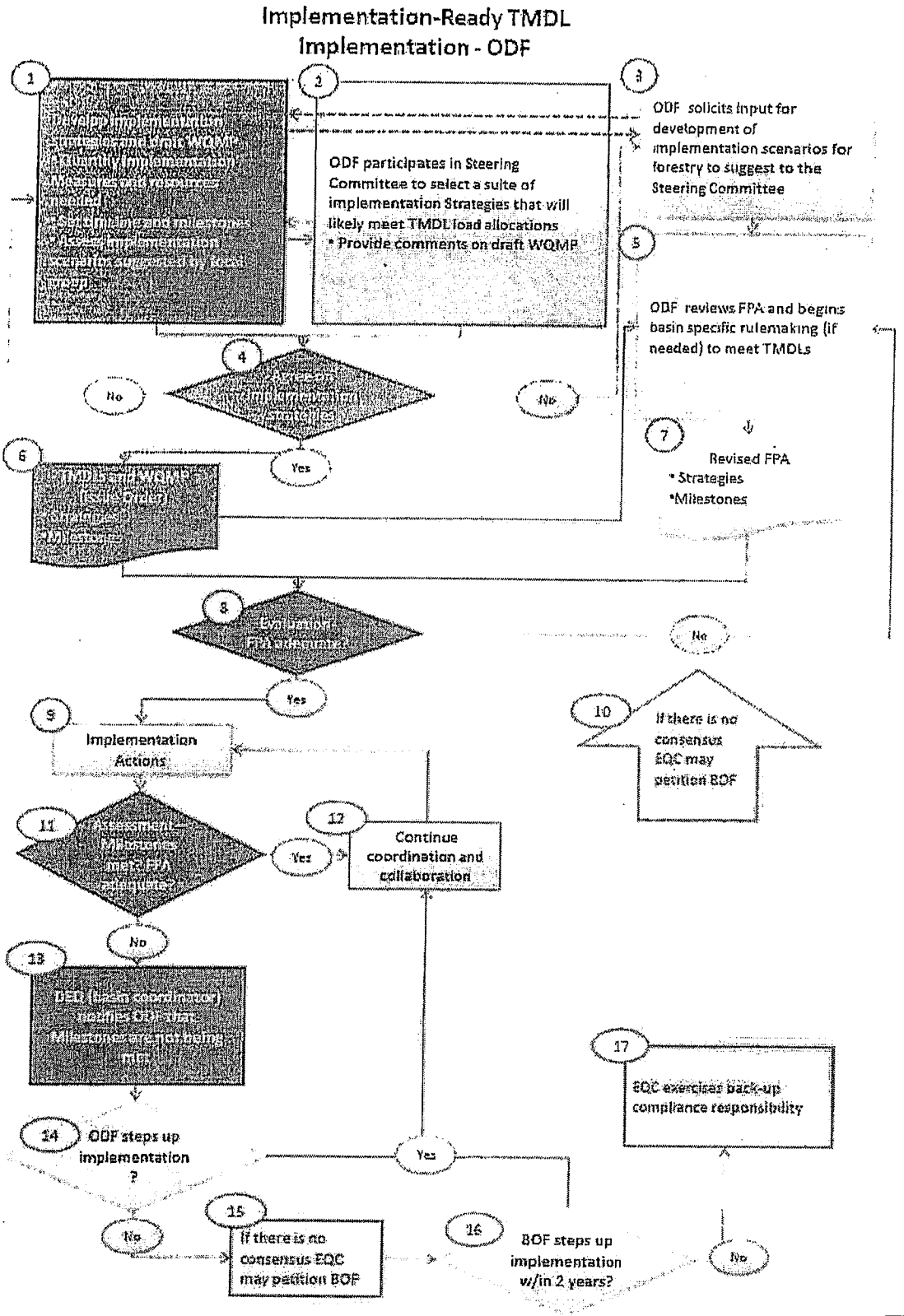
00003446


Implementation-Ready TMDL
Implementation – Urban DMA
1
2
DMA participates in Steering Committee to select a suite of Implementation Strategies that will likely meet TMDL load allocations
• Provide comments on draft WQMP
3
DMA may solicits input from its governing body for development of implementation scenarios to suggest to the Steering Committee
4
No
No
Yes
5
DMA reviews its ordinances and various plans. If needed, begin establishing ordinances and plan revisions to meet TMDLs
6
7
Revise or write TMDL Implementation Plan
• Strategies
• Milestones
8
No
Yes
9
Implementation Actions
10
If there is no consensus DEQ may take enforcement action
11
Yes
12
Continue coordination and collaboration
No
13
14
DMA steps up implementation ?
Yes
No
15
DEQ may take enforcement action
16
DMA steps up implementation ?
No
17
DEQ takes enforcement action

00003447


Implementation-Ready TMDL
Implementation - ODA
1
2
3
ODA solicits input from LAC for development of implementation scenarios for agriculture to suggest to the Steering Committee
ODA participates in Steering Committee to select a suite of implementation Strategies that will likely meet TMDL load allocations
• Provide comments on draft WQMP
5
ODA reviews AgWQM Area Plans and Rules and revises plans (and begins rulemaking if needed) to meet TMDLs
4
No
No
Yes
6
7
Revised AgWQM Area Plans and Rules
•Strategies
•Milestones
8
No
Yes
9
Implementation Actions
10
If there is no consensus EQC may petition ODA
11
Yes
12
Continue coordination and collaboration
No
13
14
ODA steps up implementation ?
Yes
No
15
If there is no consensus EQC may petition ODA
16
ODA steps up implementation ?
No
17
EQC exercises back-up compliance responsibility

00003448



These draft flow charts are under review by DEQ management and agencies

00003449

Attachment B

DIVISION 42

TOTAL MAXIMUM DAILY LOADS (TMDLS)

340-042-0025

Policy, Purpose and Effect

(1) The public policy of the State of Oregon is to protect, maintain, and improve the quality of waters of the state for beneficial uses and to provide for prevention, abatement, and control of water pollution. To achieve and maintain water quality standards, the Environmental Quality Commission may impose limitations and controls including Total Maximum Daily Loads (TMDLs), wasteload allocations for point sources, and load allocations for nonpoint sources.

(2) The policy of the Environmental Quality Commission is to have the Department of Environmental Quality establish TMDLs, including wasteload and load allocations, and have responsible sources meet these allocations through compliance with discharge permits or other strategies developed in sector or source-specific implementation plans. These measures must achieve and maintain water quality standards and restore waters of the state that are water quality limited.

(3) These rules establish procedures for developing, issuing and implementing TMDLs as required by the Federal Water Pollution Control Act Section 303(d) (33 USC Section 1313(d)) and authorized by Oregon statutes to ensure that state water quality standards are met and beneficial uses protected.

(4) The Department of Environmental Quality will review any changes to Federal Water Pollution Control Act Section 303(d) or implementing regulations in 40 CFR Part 130 promulgated after the effective date of these rules. The Department may subsequently recommend that the Environmental Quality Commission amend, repeal, or adopt new rules. Rules adopted by the Commission remain in effect until the Commission takes action on the recommendations.

[Publications: Publications referenced are available from the agency.]

Stat. Auth.: ORS 468.020, ORS 468B.020, ORS 468B.030, ORS 468B.035 & ORS 468B.110
Stats. Implemented: ORS 468B.020, ORS 468B.110
Hist.: DEQ 18-2002, f. & cert. ef. 12-20-02

340-042-0030

Definitions

In addition to the definitions provided in ORS 468.005, 468B.005, OAR 340-041-0006 and 340-045-0010, unless otherwise required by context, the following definitions apply to OAR chapter 340, division 42.

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(1) "Background Sources" include all sources of pollution or pollutants not originating from human activities. In the context of a TMDL, background sources may also include anthropogenic sources of a pollutant that the Department or another Oregon state agency does not have authority to regulate, such as pollutants emanating from another state, tribal lands or sources otherwise beyond the jurisdiction of the state.

(2) "Designated Management Agency (DMA)" means a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants, and is identified as such by the Department of Environmental Quality in a TMDL.

(3) "Director" means the Director of the Department of Environmental Quality or the Director's authorized designee.

(4) "Hydrologic Unit Code (HUC)" means a multi-scale numeric code used by the U.S. Geological Survey to classify major areas of surface drainage in the United States. The code includes fields for geographic regions, geographic sub regions, major river basins, and subbasins. The third field of the code generally corresponds to the major river basins named in OAR chapter 340, division 41. The fourth field generally corresponds to the subbasins typically addressed in TMDLs.

(5) "Local Advisory Group" means a group of people with experience and interest in a specific watershed or subbasin that is designated by the Department to provide local input during TMDL development.

(6) "Management Strategies" means measures to control the addition of pollutants to waters of the state and includes application of pollutant control practices, technologies, processes, siting criteria, operating methods, best management practices or other alternatives.

(7) "Performance Monitoring" means monitoring implementation of management strategies, including sector-specific and source-specific implementation plans, and resulting water quality changes.

(8) "Pollutant" has the meaning provided in the Federal Water Pollution Control Act Section 502 (33 USC Section 1362).

(9) "Reasonable Assurance" means a demonstration that a TMDL will be implemented by federal, state, or local governments or individuals through regulatory or voluntary actions including management strategies or other controls.

(10) "Sector" means a category or group of similar nonpoint source activities such as forestry, agriculture, recreation, urban development, or mining.

(11) "Sector-Specific Implementation Plan" or "Source-Specific Implementation Plan" in the context of a TMDL means a plan for implementing a Water Quality Management Plan for a specific sector or source not subject to permit requirements in ORS 486.050. The elements of an implementation plan are described in OAR 340-042-0080.

(12) "Source" means any process, practice, activity, or resulting condition that causes or may cause pollution or the introduction of pollutants to a waterbody.

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(13) "Subbasin" means the designation in the fourth field of the U.S. Geological Survey Hydrologic Unit Code.

(14) "Surrogate Measures" means substitute methods or parameters used in a TMDL to represent pollutants.

(15) "Total Maximum Daily Load (TMDL)" means a written quantitative plan and analysis for attaining and maintaining water quality standards and includes the elements described in OAR 340-042-0040. These elements include a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet state water quality standards, allocations of portions of that amount to the pollutant sources or sectors, and a Water Quality Management Plan to achieve water quality standards.

(16) "Waterbody" means any surface waters of the state.

(17) "Water Quality Management Plan (WQMP)" means the element of a TMDL describing strategies to achieve allocations identified in the TMDL to attain water quality standards. The elements of a WQMP are described in OAR 340-042-0040(4) (l).

[Publications: Publications referenced are available from the agency.]

Stat. Auth.: ORS 468.020, ORS 468B.020, ORS 468B.030, ORS 468B.035 & ORS 468B.110
Stats. Implemented: ORS 468B.020, ORS 468B.110
Hist.: DEQ 18-2002, f. & cert. ef. 12-20-02

340-042-0040

Establishing Total Maximum Daily Loads (TMDLs)

(1) The Department will establish TMDLs for pollutants in waters of the state that are listed in accordance with the Federal Water Pollution Control Act Section 303(d) (33 USC Section 1313(d)).

(2) The Department will group stream segments and other waterbodies geographically by subbasin and develop TMDLs for those subbasins, unless it determines another approach is warranted.

(3) The Department will prioritize and schedule TMDLs for completion considering the following factors:

(a) Severity of the pollution,

(b) Uses of the water,

(c) Availability of resources to develop TMDLs,

(d) Specific judicial requirements, and

(e) Any other relevant information.

(4) A TMDL will include the following elements:

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(a) Name and location. This element describes the geographic area for which the TMDL is developed and includes maps as appropriate.

(b) Pollutant identification. This element identifies the pollutants causing impairment of water quality that are addressed in the TMDL.

(c) Water quality standards and beneficial uses. This element identifies the beneficial uses in the basin and the relevant water quality standards, including specific basin standards established in OAR 340-041-0202 through 340-041-0975. The beneficial use that is most sensitive to impairment by the pollutant or pollutants addressed in the TMDL will be specified.

(d) Loading capacity. This element specifies the amount of a pollutant or pollutants that a waterbody can receive and still meet water quality standards. The TMDL will be set at a level to ensure that loading capacity is not exceeded. Flow assumptions used in the TMDL will be specified.

(e) Excess load. This element evaluates, to the extent existing data allow, the difference between the actual pollutant load in a waterbody and the loading capacity of that waterbody.

(f) Sources or source categories. This element identifies the pollutant sources and estimates, to the extent existing data allow, the amount of actual pollutant loading from these sources. The TMDL will establish wasteload allocations and load allocations for these sources. The Department will use available information and analyses to identify and document sources.

(g) Wasteload allocations. This element determines the portions of the receiving water's loading capacity that are allocated to existing point sources of pollution, including all point source discharges regulated under the Federal Water Pollution Control Act Section 402 (33 USC Section 1342).

(h) Load allocations. This element determines the portions of the receiving water's loading capacity that are allocated to existing nonpoint sources of pollution or to background sources. Load allocations are best estimates of loading, and may range from reasonably accurate estimates to gross allotments depending on the availability of data and appropriate techniques for predicting loading. Whenever reasonably feasible, natural background and anthropogenic nonpoint source loads will be distinguished from each other.

(i) Margin of safety. This element accounts for uncertainty related to the TMDL and, where feasible, quantifies uncertainties associated with estimating pollutant loads, modeling water quality and monitoring water quality. The TMDL will explain how the margin of safety was derived and incorporated into the TMDL.

(j) Seasonal variation. This element accounts for seasonal variation and critical conditions in stream flow, sensitive beneficial uses, pollutant loading and water quality parameters so that water quality standards will be attained and maintained during all seasons of the year.

(k) Reserve capacity. This element is an allocation for increases in pollutant loads from future growth and new or expanded sources. The TMDL may allocate no reserve capacity and explain that decision.

00003453

(I) Water quality management plan (WQMP). This element provides the framework of management strategies to attain and maintain water quality standards. The framework is designed to work in conjunction with detailed plans and analyses provided in sector-specific or source-specific implementation plans. The WQMP will address the following:

(A) Condition assessment and problem description.

(B) Goals and objectives.

(C) Proposed management strategies designed to meet the wasteload allocations and load allocations in the TMDL. This will include a categorization of sources and a description of the management strategies proposed for each source category.

(D) Timeline for implementing management strategies including:

(i) Schedule for revising permits,

(ii) Schedule for achieving appropriate incremental and measurable water quality targets,

(iii) Schedule for implementing control actions, and

(iv) Schedule for completing other measurable milestones.

(E) Explanation of how implementing the management strategies will result in attainment of water quality standards.

(F) Timeline for attainment of water quality standards.

(G) Identification of persons, including Designated Management Agencies (DMAs), responsible for implementing the management strategies and developing and revising sector-specific or source-specific implementation plans.

(H) Identification of sector-specific or source-specific implementation plans that are available at the time the TMDL is issued.

(I) Schedule for preparation and submission of sector-specific or source-specific implementation plans by responsible persons, including DMAs, and processes that trigger revisions to these implementation plans.

(J) Description of reasonable assurance that management strategies and sector-specific or source-specific implementation plans will be carried out through regulatory or voluntary actions.

(K) Plan to monitor and evaluate progress toward achieving TMDL allocations and water quality standards including:

(i) Identification of persons responsible for monitoring, and

(ii) Plan and schedule for reviewing monitoring information and revising the TMDL.

00003454

(L) Plan for public involvement in implementing management strategies.

(M) Description of planned efforts to maintain management strategies over time.

(N) General discussion of costs and funding for implementing management strategies. Sector-specific or source-specific implementation plans may provide more detailed analyses of costs and funding for specific management strategies.

(O) Citation of legal authorities relating to implementation of management strategies.

(5) To determine allocations for sources identified in the TMDL, the Department:

(a) Will use water quality data analyses, which may include statistical analyses or mathematical models.

(b) May use surrogate measures to estimate allocations for pollutants addressed in the TMDL. The Department may use one or more surrogate measures for a pollutant that is difficult to measure or highly variable. A surrogate measure will be closely related to the pollutant, and may be easier to monitor and track. The TMDL will establish the correlation between the surrogate measure and pollutant.

(6) The Department will distribute wasteload and load allocations among identified sources and in doing so, may consider the following factors:

(a) Contributions from sources;

(b) Costs of implementing measures;

(c) Ease of implementation;

(d) Timelines for attainment of water quality standards;

(e) Environmental impacts of allocations;

(f) Unintended consequences;

(g) Reasonable assurances of implementation; and

(h) Any other relevant factor.

(7) After issuing the TMDL, the Department may revise the loading capacity and allocations to accommodate changed needs or new information. In making these revisions, the Department will comply with the public notice provisions in OAR 340-042-0050(2) and procedures for issuing TMDL orders in OAR 340-042-0060.

(8) If the Environmental Protection Agency establishes a TMDL addressing waterbodies in Oregon, the Department may prepare a WQMP to implement that TMDL

[Publications: Publications referenced are available from the agency.]

00003455

Stat. Auth.: ORS 468.020, ORS 468B.020, ORS 468B.030, ORS 468B.035 & ORS 468B.110
Stats. Implemented: ORS 468B.020, ORS 468B.110
Hist.: DEQ 18-2002, f. & cert. ef. 12-20-02

340-042-0050

Public Participation

(1) The Department will establish a local advisory group or identify an existing group or forum to assist in developing a TMDL.

(2) The Department will provide an opportunity for persons to review and comment on a draft TMDL and on proposals to revise loading capacity or allocations in a TMDL as follows:

(a) The Department will maintain a mailing list for each TMDL.

(b) The Department will provide notice and an opportunity for public comment on a proposed TMDL or revision to loading capacity or allocations in a TMDL. The public comment period will generally be 60 days.

(c) The Department will respond to public comments received during the public comment period and will prepare a written summary of responses.

Stat. Auth.: ORS 468.020, ORS 468B.020, ORS 468B.030, ORS 468B.035 & ORS 468B.110
Stats. Implemented: ORS 468B.020, ORS 468B.110
Hist.: DEQ 18-2002, f. & cert. ef. 12-20-02

340-042-0060

Issuing a Total Maximum Daily Load

(1) The Director will issue a TMDL as an order. If the Environmental Protection Agency establishes a TMDL addressing waterbodies in Oregon, the Director may issue as an order a WQMP to implement that TMDL.

(2) The order will be effective and final on the date signed by the Director.

(3) Following issuance, the Department will submit the TMDL to the Environmental Protection Agency.

(4) Within 20 business days after the Director signs the order, the Department will notify all affected NPDES permittees, nonpoint source DMAs identified in the TMDL and persons who provided formal public comment on the draft TMDL that the order has been issued and the summary of responses to comments is available.

Stat. Auth.: ORS 468.020, ORS 468B.020, ORS 468B.030, ORS 468B.035 & ORS 468B.110
Stats. Implemented: ORS 468B.020, ORS 468B.110
Hist.: DEQ 18-2002, f. & cert. ef. 12-20-02

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340-042-0070

Requesting Reconsideration or Appealing a Total Maximum Daily Load

(1) Any person who participated in establishing a TMDL, including those who submitted comments and any other person entitled to seek judicial review of an order issuing a TMDL may request reconsideration by the Director in accordance with OAR 137-004-0080.

(2) A person may file a petition for judicial review of a final TMDL order as allowed by ORS 183.484.

Stat. Auth.: ORS 468.020, ORS 468B.020, ORS 468B.030, ORS 468B.035 & ORS 468B.110
Stats. Implemented: ORS 468B.020, ORS 468B.110
Hist.: DEQ 18-2002, f. & cert. ef. 12-20-02

340-042-0080

Implementing a Total Maximum Daily Load

(1) Management strategies identified in a WQMP to achieve wasteload and load allocations in a TMDL will be implemented through water quality permits for those sources subject to permit requirements in ORS 468B.050 and through sector-specific or source-specific implementation plans for other sources. WQMPs will identify the sector and source-specific implementation plans required and the persons, including DMAs, responsible for developing and revising those plans.

(2) The Oregon Department of Forestry will develop and enforce implementation plans addressing state and private forestry sources as authorized by ORS 527.610 through 527.992 and according to OAR chapter 629, divisions 600 through 665. The Oregon Department of Agriculture will develop implementation plans for agricultural activities and soil erosion and enforce associated rules as authorized by ORS 568.900 through 568.933 and according to OAR chapter 603, divisions 90 and 95.

(3) Persons, including DMAs other than the Oregon Department of Forestry or the Oregon Department of Agriculture, identified in a WQMP as responsible for developing and revising sector-specific or source-specific implementation plans must:

(a) Prepare an implementation plan and submit the plan to the Department for review and approval according to the schedule specified in the WQMP. The implementation plan must:

(A) Identify the management strategies the DMA or other responsible person will use to achieve load allocations and reduce pollutant loading;

(B) Provide a timeline for implementing management strategies and a schedule for completing measurable milestones;

(C) Provide for performance monitoring with a plan for periodic review and revision of the implementation plan;

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(D) To the extent required by ORS 197.180 and OAR chapter 340, division 18, provide evidence of compliance with applicable statewide land use requirements; and

(E) Provide any other analyses or information specified in the WQMP.

(b) Implement and revise the plan as needed.

(4) For sources subject to permit requirements in ORS 468B.050, wasteload allocations and other management strategies will be incorporated into permit requirements.

Stat. Auth.: ORS 468.020, ORS 468B.020, ORS 468B.030, ORS 468B.035 & ORS 468B.110
Stats. Implemented: ORS 468B.020, ORS 468B.110
Hist.: DEQ 18-2002, f. & cert. ef. 12-20-02

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Attachment C

Title 40: Protection of Environment
PART 130—WATER QUALITY PLANNING AND MANAGEMENT

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§ 130.7 Total maximum daily loads (TMDL) and individual water quality-based effluent limitations.

(a) *General.* The process for identifying water quality limited segments still requiring wasteload allocations, load allocations and total maximum daily loads (WLAs/LAs and TMDLs), setting priorities for developing these loads; establishing these loads for segments identified, including water quality monitoring, modeling, data analysis, calculation methods, and list of pollutants to be regulated; submitting the State's list of segments identified, priority ranking, and loads established (WLAs/LAs/TMDLs) to EPA for approval; incorporating the approved loads into the State's WQM plans and NPDES permits; and involving the public, affected dischargers, designated areawide agencies, and local governments in this process shall be clearly described in the State Continuing Planning Process (CPP).

(b) Identification and priority setting for water quality-limited segments still requiring TMDLs.

(1) Each State shall identify those water quality-limited segments still requiring TMDLs within its boundaries for which:

(i) Technology-based effluent limitations required by sections 301(b), 306, 307, or other sections of the Act;

(ii) More stringent effluent limitations (including prohibitions) required by either State or local authority preserved by section 510 of the Act, or Federal authority (law, regulation, or treaty); and

(iii) Other pollution control requirements (e.g., best management practices) required by local, State, or Federal authority are not stringent enough to implement any water quality standards (WQS) applicable to such waters.

(2) Each State shall also identify on the same list developed under paragraph (b)(1) of this section those water quality-limited segments still requiring TMDLs or parts thereof within its boundaries for which controls on thermal discharges under section 301 or State or local requirements are not stringent enough to assure protection and propagation of a balanced indigenous population of shellfish, fish and wildlife.

(3) For the purposes of listing waters under §130.7(b), the term "water quality standard applicable to such waters" and "applicable water quality standards" refer to those water quality standards established under section 303 of the Act, including numeric criteria, narrative criteria, waterbody uses, and antidegradation requirements.

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(4) The list required under §§130.7(b)(1) and 130.7(b)(2) of this section shall include a priority ranking for all listed water quality-limited segments still requiring TMDLs, taking into account the severity of the pollution and the uses to be made of such waters and shall identify the pollutants causing or expected to cause violations of the applicable water quality standards. The priority ranking shall specifically include the identification of waters targeted for TMDL development in the next two years.

(5) Each State shall assemble and evaluate all existing and readily available water quality-related data and information to develop the list required by §§130.7(b)(1) and 130.7(b)(2). At a minimum "all existing and readily available water quality-related data and information" includes but is not limited to all of the existing and readily available data and information about the following categories of waters:

(i) Waters identified by the State in its most recent section 305(b) report as "partially meeting" or "not meeting" designated uses or as "threatened";

(ii) Waters for which dilution calculations or predictive models indicate nonattainment of applicable water quality standards;

(iii) Waters for which water quality problems have been reported by local, state, or federal agencies; members of the public; or academic institutions. These organizations and groups should be actively solicited for research they may be conducting or reporting. For example, university researchers, the United States Department of Agriculture, the National Oceanic and Atmospheric Administration, the United States Geological Survey, and the United States Fish and Wildlife Service are good sources of field data; and

(iv) Waters identified by the State as impaired or threatened in a nonpoint assessment submitted to EPA under section 319 of the CWA or in any updates of the assessment.

(6) Each State shall provide documentation to the Regional Administrator to support the State's determination to list or not to list its waters as required by §§130.7(b)(1) and 130.7(b)(2). This documentation shall be submitted to the Regional Administrator together with the list required by §§130.7(b)(1) and 130.7(b)(2) and shall include at a minimum:

(i) A description of the methodology used to develop the list; and

(ii) A description of the data and information used to identify waters, including a description of the data and information used by the State as required by §130.7(b)(5); and

(iii) A rationale for any decision to not use any existing and readily available data and information for any one of the categories of waters as described in §130.7(b)(5); and

(iv) Any other reasonable information requested by the Regional Administrator. Upon request by the Regional Administrator, each State must demonstrate good cause for not including a water or waters on the list. Good cause includes, but is not limited to, more recent or accurate data; more

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sophisticated water quality modeling; flaws in the original analysis that led to the water being listed in the categories in §130.7(b)(5); or changes in conditions, e.g., new control equipment, or elimination of discharges.

(c) Development of TMDLs and individual water quality based effluent limitations.

(1) Each State shall establish TMDLs for the water quality limited segments identified in paragraph (b)(1) of this section, and in accordance with the priority ranking. For pollutants other than heat, TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical WQS with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. Determinations of TMDLs shall take into account critical conditions for stream flow, loading, and water quality parameters.

(i) TMDLs may be established using a pollutant-by-pollutant or biomonitoring approach. In many cases both techniques may be needed. Site-specific information should be used wherever possible.

(ii) TMDLs shall be established for all pollutants preventing or expected to prevent attainment of water quality standards as identified pursuant to paragraph (b)(1) of this section. Calculations to establish TMDLs shall be subject to public review as defined in the State CPP.

(2) Each State shall estimate for the water quality limited segments still requiring TMDLs identified in paragraph (b)(2) of this section, the total maximum daily thermal load which cannot be exceeded in order to assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife. Such estimates shall take into account the normal water temperatures, flow rates, seasonal variations, existing sources of heat input, and the dissipative capacity of the identified waters or parts thereof. Such estimates shall include a calculation of the maximum heat input that can be made into each such part and shall include a margin of safety which takes into account any lack of knowledge concerning the development of thermal water quality criteria for protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in the identified waters or parts thereof.

(d) *Submission and EPA approval.* (1) Each State shall submit biennially to the Regional Administrator beginning in 1992 the list of waters, pollutants causing impairment, and the priority ranking including waters targeted for TMDL development within the next two years as required under paragraph (b) of this section. For the 1992 biennial submission, these lists are due no later than October 22, 1992. Thereafter, each State shall submit to EPA lists required under paragraph (b) of this section on April 1 of every even-numbered year. For the year 2000 submission, a State must submit a list required under paragraph (b) of this section only if a court order or consent decree, or commitment in a settlement agreement dated prior to January 1, 2000, expressly requires EPA to take action related to that State's year 2000 list. For the year 2002 submission, a State must submit a list required under paragraph (b) of this section by October 1, 2002, unless a court order, consent decree or commitment in a settlement agreement expressly requires EPA to take an action related to that State's 2002 list prior to October 1, 2002, in which case, the State must submit a list by April 1, 2002. The list of waters may be submitted as part of the State's biennial water quality report

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required by §130.8 of this part and section 305(b) of the CWA or submitted under separate cover. All WLAs/LAs and TMDLs established under paragraph (c) for water quality limited segments shall continue to be submitted to EPA for review and approval. Schedules for submission of TMDLs shall be determined by the Regional Administrator and the State.

(2) The Regional Administrator shall either approve or disapprove such listing and loadings not later than 30 days after the date of submission. The Regional Administrator shall approve a list developed under §130.7(b) that is submitted after the effective date of this rule only if it meets the requirements of §130.7(b). If the Regional Administrator approves such listing and loadings, the State shall incorporate them into its current WQM plan. If the Regional Administrator disapproves such listing and loadings, he shall, not later than 30 days after the date of such disapproval, identify such waters in such State and establish such loads for such waters as determined necessary to implement applicable WQS. The Regional Administrator shall promptly issue a public notice seeking comment on such listing and loadings. After considering public comment and making any revisions he deems appropriate, the Regional Administrator shall transmit the listing and loads to the State, which shall incorporate them into its current WQM plan.

(e) For the specific purpose of developing information and as resources allow, each State shall identify all segments within its boundaries which it has not identified under paragraph (b) of this section and estimate for such waters the TMDLs with seasonal variations and margins of safety, for those pollutants which the Regional Administrator identifies under section 304(a)(2) as suitable for such calculation and for thermal discharges, at a level that would assure protection and propagation of a balanced indigenous population of fish, shellfish and wildlife. However, there is no requirement for such loads to be submitted to EPA for approval, and establishing TMDLs for those waters identified in paragraph (b) of this section shall be given higher priority.

[50 FR 1779, Jan. 11, 1985, as amended at 57 FR 33049, July 24, 1992; 65 FR 17170, Mar. 31, 2000; 66 FR 53048, Oct. 18, 2001]

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Divisions 41 and 42 Proposed Rule Changes to Clarify Regulation around of Nonpoint Sources of Pollution

Draft Issue Paper

I. Introduction

A. Context

The Environmental Quality Commission (EQC) directed the Department of Environmental Quality (the department) to review existing rules and programs to identify gaps and propose strategies including rule changes that would reduce toxics in Oregon waters that come from nonpoint sources and other sources not regulated by permits under section 402 of the federal Clean Water Act.

The department is considering a number of items for inclusion in the toxics standards rulemaking package, including revisions to the Oregon Administrative Rules (OAR) related to regulating forestry and agricultural land management in the Water Quality Standards (Divisions 41) and Total Maximum Daily Loads Rules (Division 42). The intent of revising rules in Divisions 41 and 42 for nonpoint sources is to clarify the department's regulatory authority and the department's interaction with Oregon Departments of Agriculture and Forestry to control nonpoint sources of pollution.

B. Purpose, Why we are doing this now

The purpose for considering revisions to the Divisions 41 and 42 rules is to determine whether changes would further the goal of reducing and preventing toxic pollutants from non-NPDES sources in waters of the state. As part of the current review of Oregon's human health toxics criteria, the department is working with a non-NPDES stakeholder group (See attached list) to determine if additional language is needed to reduce or prevent the release of toxic pollutants from non-NPDES sources to waters of the state.

The department believes that rules in divisions 41 and 42 should reflect the intent of related statutes. The department therefore proposes to revise rules in Divisions 41 and 42 during the toxics rulemaking process to capture the intent of related statutes as to how nonpoint sources are expected to meet water quality standards and TMDL load allocations.

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II Background

A. History

Under the Clean Water Act (CFR 130.7) and state statute (ORS 468), the department is authorized to develop, implement, and enforce Water Quality Standards and TMDLs. Under several rules in Divisions 41 and 42, there are sections that describe how rules are expected to be implemented for urban, agricultural and forestry nonpoint sources. The rules in Division 41 for agricultural and forestry nonpoint sources were either added or significantly revised in 2004 when the department revised its temperature standards. Oregon's TMDL rules were adopted by the EQC in 2002.

B. Problem Description

In Oregon, there are toxic chemicals on 303(d) list for certain segments of waterbodies due to water quality standards exceedances. In addition, concerns about the level and variety of toxics in Oregon waters have been highlighted in various studies by governmental agencies, such as USGS and the agency. These concerns have also been raised by citizens, environmental groups, as well as the EQC. Toxic pollutants come from various point sources and nonpoint sources. Toxic pollutants from nonpoint sources could include both current use and legacy sources. Examples of these sources include pesticides, metals, fertilizers, urban stormwater, and others. Some toxics may be applied intentionally, like pesticides, while other could be unintentionally via air deposition. In either case, the toxics are transported to water bodies in runoff or attached to sediment.

There are many partners that have been actively working on pollution control associated with agricultural and forestry activities. These partners include individual land owners, Departments of Agriculture, Forestry, and State Lands, various Soil and Water Conservation Districts, cities, counties, federal land management agencies, and Natural Resource Conservation Service. Despite all the efforts made by these partners to reducing the amount of toxics entering waterbodies, they are still not meeting water quality standards for toxic pollutants.

In Oregon, the State legislature intended to protect and enhance water quality by integrating nonpoint source concerns into State and Federal programs. Oregon Revised Statutes such as ORS 527 and 568 describe the mechanisms for forestry and agricultural nonpoint sources to meet applicable water quality standards. The rules under Division 41 related to agriculture and forestry do not, however, explicitly state that nonpoint sources need to meet water quality standards. The sections related to agriculture and forestry under Division 42 do not explain the department's authority around agricultural and forestry activities and how it should work with other regulatory agencies either.

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C. Oregon's Water Quality rules for Agricultural and Forestry nonpoint sources

The department is authorized under the state statute 468B to implement and enforce the federal Clean Water Act within Oregon. The state legislature also gave authority to other state agencies to address nonpoint sources of pollution from agricultural and forest lands. See Authorities related to Nonpoint Source Pollution Prevention and Control Memo (DEQ, 2010)

D. Federal Regulation and Guidance for Agricultural and Forestry nonpoint sources

National policy on nonpoint source pollution was added to the Clean Water Act in 1987 in order for the goal of the Act to be met through control of both point and nonpoint sources of pollution. This revision mainly addressed urban stormwater.

In addition, EPA provides a number of sector specific guidance documents and watershed planning for implementation. (Available at: http://www.epa.gov/owow/nps/) It should be noted that guidance documents do not carry the same authority as the CWA.)

III. DEQ Recommendations for Clarifying Regulation around Nonpoint Sources of Pollution

Summary

DEQ reviewed potential approaches to revise rules in Divisions 41 and 42 to clarify DEQ's regulatory authority to control nonpoint sources of pollution.

The following rules under Divisions 41 and 42 are proposed to be amended.

A. 340-041-0007 Statewide Narrative Criteria
B. 340-041-0061 Other Implementation of Water Quality Criteria
C. 340-042-0080 Implementing a Total Maximum Daily Load
D. 340-42-0040 Establishing Total Maximum Daily Load

DEQ considered adding a definition of forest activities that are not covered under the Forest Practices Act in Division 41. Due to the complexity of the regulations and exceptions, however, DEQ determined that the best approach to clarify forest activities that are not applicable to Forest Practices Act is through a memo or a fact sheet rather than in a rule. This item is therefore no longer included in the rule package.

E. 340-42-0002 Definitions

A. 340-041-0007 Statewide Narrative Criteria

The statewide narrative criteria portion of the water quality standards describes pollutants that the department has not developed a numeric criteria. Oregon's narrative criteria rule includes a section on logging and forest activities to explain the commission's expectation for those sources and the intent of related statutes.

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In order to clarify the expectation for logging and forest management activities, revising section (5) of Statewide Narrative Criteria rule has been proposed. Proposed language for 7/15 meeting differs from previously proposed draft language by recognizing that all forest management activities including those that occur on federal forest lands are subject to the water quality standards. Language following that broader statement is narrowly tailored to the existing statutes related to state and private forestlands.

Applicability/Scope

This solution would be applied statewide for all forest management activities including those that occur on federal forest lands.

DEQ Recommendation

Current Language

340-041-0007(5) Logging and forest management activities must be conducted in accordance with the Oregon Forest Practices Act to minimize adverse effects on water quality.

Proposed Language for 10/4 Meeting (No change from 7/15 draft)

340-041-0007(5) Logging and forest management activities must be conducted in accordance with the ~~Oregon Forest Practices Act to minimize adverse effects on water quality.~~ water quality standards and implementing rules established by the Environmental Quality Commission. Nonpoint source discharges of pollutants from forest operations on state and private forest lands are subject to best management practices and other control measures established by the Oregon Board of Forestry as provided in ORS 527.765 and 527.770. Forest operations conducted in good faith compliance with the best management practices and control measures established under the Forest Practice Act are generally deemed not to cause violations of water quality standards as provided in ORS 527.770. Forest operations may be subject to load allocations established under ORS 468B.110 and OAR 340-042, however, to the extent needed to implement the federal Clean Water Act.

Proposed Language for 10/4 meeting without track changes

340-041-0007(5) Logging and forest management activities must be conducted in accordance with the water quality standards and implementing rules established by the Environmental Quality Commission. Nonpoint source discharges of pollutants from forest operations on state and private forest lands are subject to best management practices and other control measures established by the Oregon Board of Forestry as provided in ORS 527.765 and 527.770. Forest operations conducted in good faith compliance with the best management practices and control measures established under the Forest Practice Act are generally deemed not to cause violations of water quality standards as provided in ORS527.770. Forest operations may be subject to load allocations established under ORS 468B.110 and OAR 340-042, however, to the extent needed to implement the federal Clean Water Act.

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Policy objective

The objective of this section of the narrative criteria is to explain the commission's policy and the intent of related statutes as to how logging and forest activities should be regulated to meet the narrative criteria rule.

Policy evaluation

Advantages and disadvantages

The new language is applicable to both federal and non-federal forest activities, and clarifies that forest management activities need to meet water quality standards.

Summary of RWG discussion and views (RWG, please provide additional comments if your view is not reflected in this section)

The rulemaking workgroup has discussed revisions to this rule at several meetings and the department met with individual members for additional discussions as requested.

- Some of the workgroup members have questioned the department's authority to regulate forest operations under ORS468B.110 and OAR 340-042. The department provided an AG's opinion that explains this issue to the workgroup.
- Some of the stakeholders also expressed discomfort with the language and said that the tone of the language would not encourage voluntary actions by landowners. The department reiterated that the purpose for revising the rule is to clarify its backup authority and not to discourage voluntary actions and existing collaborative relationships between agencies.
- While some workgroup members suggested changes to proposed language, others did not provide specific suggestions because they disagree with the interpretation of the statutes expressed in the proposed language.

Authority and precedence

This is an existing section under the statewide narrative criteria rule. EQC has authority under 468B 110.

B. *340-041-0061 Other Implementation of Water Quality Criteria*

This portion of the water quality standards describes EQC's expectation for how water quality criteria are implemented, and includes sections on agriculture and forestry.

DEQ proposes to revise sections (11) and (12) of this rule to clarify DEQ's authority around nonpoint source regulation and to describe how water quality standards are generally

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implemented on agricultural and forest lands. Proposed rule language reflects DEQ's further consideration to communicate the intent of related statutes and rules.

Applicability/Scope

These sections of the Other Implementation of Water Quality Criteria are applicable statewide for all waters of the state.

DEQ Recommendation

Forestry

Current Language

340-041-0061(11) Forestry on state and private lands. For forest operations on state or private lands, water quality standards are intended to be attained and are implemented through best management practices and other control mechanisms established under the Forest Practices Act (ORS 527.610 to 527.992) and rules thereunder, administered by the Oregon Department of Forestry. Therefore, forest operations that are in compliance with the Forest Practices Act requirements are (except for the limits set out in ORS 527.770) deemed in compliance with this division. DEQ will work with the Oregon Department of Forestry to revise the Forest Practices program to attain water quality standards.

Proposed Language for forestry for 10/4 Meeting (No change from 7/15 meeting)

340-041-0061(11) Forestry on state and private lands. Nonpoint source discharges of pollutants from ~~For~~ forest operations on state or private lands are subject to~~, water quality standards are intended to be attained and are implemented through~~ best management practices and other control measures ~~mechanisms~~ established by the Oregon Department of Forestry under the Forest Practices Act (ORS 527.610 to 527.992)~~, and rules thereunder, administered by the Oregon Department of Forestry. Therefore, f~~Such forest operations, when conducted in good faith ~~that are in~~ compliance with the Forest Practices Act requirements are generally deemed not to cause violations of water quality standards as provided in ~~(except for the limits set out in~~ ORS 527.770~~)~~. ~~Forest operations on state and private lands may be subject to load allocations under ORS 468.110 and OAR 340, Division 42 to the extent necessary to implement the federal Clean Water Act, deemed in compliance with this division. DEQ will work with the Oregon Department of Forestry to revise the Forest Practices program to attain water quality standards.~~

Proposed language for forestry for 10/4 Meeting without track changes

340-041-0061(11) Forestry on state and private lands. Nonpoint source discharges of pollutants from forest operations on state or private lands are subject to best management practices and other control measures established by the Oregon Department of Forestry under the Forest Practices Act (ORS 527.610 to 527.992). Such forest operations, when conducted in good faith compliance with the Forest Practices Act requirements are generally deemed not to cause violations of water quality standards as provided in ORS 527.770. Forest operations on state

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and private lands may be subject to load allocations under ORS 468.110 and OAR 340, Division 42 to the extent necessary to implement the federal Clean Water Act.

Agriculture

Current Language

340-041-0061(12) Agricultural water quality management plans to reduce agricultural nonpoint source pollution are developed and implemented by the Oregon Department of Agriculture (ODA) through a cooperative agreement with the department to implement applicable provisions of ORS 568.900 to 568.933 and 561.191. If the department has reason to believe that agricultural discharges or activities are contributing to water quality problems resulting in water quality standards violations, the department may consult with the ODA. If water quality impacts are likely from agricultural sources and the department determines that a water quality management plan is necessary, the director may write a letter to the director of the ODA requesting that such a management plan be prepared and implemented to reduce pollutant loads and achieve the water quality criteria.

Proposed Language for agriculture for 10/4 Meeting

340-041-0061(12) In areas subject to the Agricultural Wwater Qquality Mmanagement Act ~~plans to reduce agricultural nonpoint source pollution are developed and implemented by~~ the Oregon Department of Agriculture (ODA) ~~through a cooperative agreement with the department to implement applicable provisions of~~ under ORS 568.900 to 568.933 and 561.191 develops and implements agricultural water quality management area plans and rules to prevent and control water pollution from agricultural activities and soil erosion on agricultural and rural lands. Area plans and rules must be designed to achieve and maintain water quality standards. If the department ~~has reason to believe~~ determines that the area plan and rules are not adequate to ~~agricultural discharges or activities are contributing to water quality problems resulting in~~ achieve and maintain water quality standards, the department will provide ODA with comments on what would be sufficient to meet WQS or TMDL load allocations. In addition, the department may request the Environmental Quality Commission (EQC) to petition violations, ~~the department may consult with the~~ ODA for a review of part or all of ~~. If water quality impacts are likely from agricultural sources and the department determines that a~~ water quality management area plan and rules. If a landowner's activities are causing or contributing to water quality standards violations, the department will refer the activity to ODA for further evaluation and potential requirements. The department may also require remedies of landowner causing pollution or contributing to water quality standards violation if ODA does not take action. ~~is necessary, the director may write a letter to the director of the ODA requesting that such a management plan be prepared and implemented to reduce pollutant loads and achieve the water quality criteria.~~

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Proposed Language for agriculture for 10/4 Meeting without track changes

340-041-0061(12) In areas subject to the Agricultural Water Quality Management Act the Oregon Department of Agriculture (ODA) under ORS 568.900 to 568.933 and 561.191 develops and implements agricultural water quality management area plans and rules to prevent and control water pollution from agricultural activities and soil erosion on agricultural and rural lands. Area plans and rules must be designed to achieve and maintain water quality standards. If the department determines that the area plan and rules are not adequate to achieve water quality standards, the department will provide ODA with comments on what would be sufficient to meet WQS or TMDL load allocations. In addition, the department may request the Environmental Quality Commission to petition ODA for a review of part or all of water quality management area plan and rules. If a landowner's activities are causing or contributing to water quality standards violations, the department will refer the activity to ODA for further evaluation and potential requirements. The department may also require remedies of landowner causing pollution or contributing to water quality standards violation if ODA does not take action.

Rule objective

The objective of these sections of the rule is to describe EQC's expectation for how water quality criteria are implemented on agricultural and forest lands.

Rule evaluation

Advantages and disadvantages

Revising these sections of the rule will clarify how relevant statutes and rules are used to control non-NPDES sources on agricultural and forest lands.

Summary of RWG discussion and views ***(RWG, please provide additional comments if your view is not reflected in this section)***

The rulemaking workgroup discussed revisions to this rule at several meetings.

- For the proposed rule language for forestry, the stakeholders expressed their support and concerns that were similar to those for 340-041-0007. While some workgroup members suggested specific language, those who disagree with the interpretation of the statutes expressed in the proposed language chose not to provide alternative language.
- Some workgroup members disagreed on whether the department should retain its authority under statutes for taking enforcement actions on agricultural activities instead of ODA taking the lead. The department explained that currently ODA does take the lead when dealing with compliance issues. The department further explained that, except for some isolated cases, the department did not expect the arrangement to change as a result of the proposed rule change.

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- Some of the workgroup members have questioned the department's authority to regulate forest operations and activities on agricultural and rural lands under ORS468B.110 and OAR 340-042. While some thought that it was important to include the department's authority in rule, others did not think it was appropriate. The department provided an AG's opinion that explains the state of Oregon's interpretation regarding forestry and authorities under statutes for sources other than forestry.

Authority and precedence

Sections on agricultural water quality management area plans and forest lands are included under existing rule.

C. *340-042-0080 Implementing a Total Maximum Daily Load*

This rule describes the EQC's expectations for how TMDLs are implemented in various ways including through permits and other programs.

The department proposes to provide expectations under this rule for agricultural and forestry nonpoint sources for meeting TMDL load allocations. The revised rule language will provide added assurance that water quality will improve. (See TMDL issue paper for more details) The proposed rule change is focused around agriculture and forestry since authority under TMDL rule for urban sources is clearer.

Applicability/Scope

This section of the rule applies statewide.

DEQ Recommendation

Current Language

340-042-0080(2) The Oregon Department of Forestry will develop and enforce implementation plans addressing state and private forestry sources as authorized by ORS 527.610 through 527.992 and according to OAR chapter 629, divisions 600 through 665. The Oregon Department of Agriculture will develop implementation plans for agricultural activities and soil erosion and enforce associated rules as authorized by ORS 568.900 through 568.933 and according to OAR chapter 603, divisions 90 and 95.

Proposed Language for 10/4 Meeting

340-042-0080(2) Nonpoint source discharges of pollutants from forest operations on state or private lands are subject to best management practices and other control measures established by tThe Oregon Department of Forestry under ~~will develop and enforce implementation plans addressing state and private forestry sources as authorized by~~ ORS 527.610 through 527.992 and according to OAR chapter 629, divisions 600 through 665. Such forest operations, when conducted in good faith compliance with the Forest Practices Act requirements are generally

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deemed not to cause violations of water quality standards as provided in ORS 527.770. The department may also assign sector or source specific load allocations needed for nonpoint sources of pollution on state and private forestlands to implement the load allocations. In areas where a TMDL has been approved, Forest Practices Act rules may need to be revised to meet the TMDL load allocations. If the department determines that the Forest Practices Act rules are not adequate to implement the load allocation, the department may request the Environmental Quality Commission to petition the Board of Forestry for a review of part or all of Forest Practices Act rules implementing the TMDL.

340-042-0080(3) In areas subject to the Agricultural Water Quality Management Act tThe Oregon Department of Agriculture (ODA) ~~will develop implementation plans for agricultural activities and soil erosion and enforce associated rules as authorized by~~ under ORS 568.900 through 568.933 and according to OAR chapter 603, divisions 90 and 95 develops and implements agricultural water quality management area plans and rules to prevent and control water pollution from agricultural activities and soil erosion on agricultural and rural lands. The department may also assign sector or source specific load allocations needed for agricultural or rural residential nonpoint sources to implement the load allocations. In areas where a TMDL has been approved, agricultural water quality management area plans and rules must be sufficient to meet the TMDL load allocations. If the department determines that the plan and rules are not adequate to implement the load allocation, the department may request the Environmental Quality Commission to petition ODA for a review of part or all of water quality management area plan and rules implementing the TMDL.

Proposed Language for 10/4 Meeting without track changes

340-042-0080(2) Nonpoint source discharges of pollutants from forest operations on state or private lands are subject to best management practices and other control measures established by the Oregon Department of Forestry under the ORS 527.610 to 527.992 and according to OAR chapter 629, divisions 600 through 665. Such forest operations, when conducted in good faith compliance with the Forest Practices Act requirements are generally deemed not to cause violations of water quality standards as provided in ORS 527.770. The department may also assign sector or source specific load allocations needed for nonpoint sources of pollution on state and private forestlands to implement the load allocations. In areas where a TMDL has been approved, Forest Practices Act rules may need to be revised to meet the TMDL load allocations. If the department determines that the Forest Practices Act rules are not adequate to implement the load allocation, the department may request the Environmental Quality Commission to petition the Board of Forestry for a review of part or all of Forest Practices Act rules implementing the TMDL.

340-042-0080(3) In areas subject to the Agricultural Water Quality Management Act the Oregon Department of Agriculture (ODA) under ORS 568.900 to 568.933 and 561.191 and according to OAR chapter 603, divisions 90 and 95 develops and implements agricultural water quality

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management area plans and rules to prevent and control water pollution from agricultural activities and soil erosion on agricultural and rural lands. The department may also assign sector or source specific load allocations needed for agricultural or rural residential nonpoint sources to implement the load allocations. In areas where a TMDL has been approved, agricultural water quality management area plans and rules must be sufficient to meet the TMDL load allocations. If the department determines that the plan and rules are not adequate to implement the load allocation, the department may request the Environmental Quality Commission to petition ODA for a review of part or all of water quality management area plan and rules implementing the TMDL.

Policy objective

This rule describes the EQC's expectations for how TMDLs are implemented in various ways including through permits and other programs.

Policy evaluation

Advantages and disadvantages

Explaining how the department may provide more specificity in its source analyses and assign load allocations at a finer scale would clarify the EQC policy for addressing nonpoint sources.

Summary of RWG discussion and views (RWG, please provide additional comments if your view is not reflected in this section)

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The rulemaking workgroup has discussed revisions to this rule at several meetings.

- Some thought that it was important to include the department's authority in this rule, and others did not think it was appropriate.
- Some of the workgroup members questioned the department's authority to assign source specific load allocations.
- Others expressed concern that the department may require specific measures for forest operations and activities on agricultural and rural lands under ORS468B.110 and OAR 340-042. The department emphasized its desire to work with ODA and local stakeholders during TMDL process and explained the need to clarify its authority to use surrogate measures.

Authority and precedence

Under the current rule language in Division 42, the department already has authority to do what is currently proposed.

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D. *340-42-0040 Establishing Total Maximum Daily Load*

This rule explains the steps that need to be taken to establish TMDLs as well as list what elements are required in a TMDL. Although the department has authority to do so already, its ability to identifying significant air and land sources and assign Waste Load Allocations (WLAs) for point sources and Load Allocations (LA) for non-NPDES sources is not explicit in the Division 42 TMDL rule. The department proposes to revise this rule to clarify DEQ's authority to assign an individual load allocation to air and land sources in TMDLs.

It should be noted that the department made a policy decision to limit the scope of the toxics water quality standards rulemaking to water program. The actual regulatory mechanism for addressing TMDL allocations through other media programs still needs to be defined and described in the administrative rules affecting air quality and land quality programs. The approach described below is one potential strategy that the department will consider during Toxics Reduction Strategy development.

Applicability/Scope

This rule is applicable statewide.

DEQ Recommendation

Current Language

340-042-0040(h) Load allocations. This element determines the portions of the receiving water's loading capacity that are allocated to existing nonpoint sources, or to background sources. Load allocations are best estimates of loading, and may range from reasonably accurate estimates to gross allotments depending on the availability of data and appropriate techniques for predicting loading. Whenever reasonably feasible, natural background and anthropogenic nonpoint source loads will be distinguished from each other.

Proposed Language for 10/4 Meeting (No change from 8/15 meeting)

340-042-0040(h) Load allocations. This element determines the portions of the receiving water's loading capacity that are allocated to existing nonpoint sources, including runoff, deposition, soil contamination and groundwater discharges, or to background sources. Load allocations are best estimates of loading, and may range from reasonably accurate estimates to gross allotments depending on the availability of data and appropriate techniques for predicting loading. Whenever reasonably feasible, natural background, long-range transport and anthropogenic nonpoint source loads will be distinguished from each other.

Proposed Language for 10/4 Meeting without track changes

(h) Load allocations. This element determines the portions of the receiving water's loading capacity that are allocated to existing nonpoint sources, including runoff, deposition, soil contamination and groundwater discharges, or to background sources. Load allocations are best estimates of loading, and may range from reasonably accurate estimates to gross allotments

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depending on the availability of data and appropriate techniques for predicting loading. Whenever reasonably feasible, natural background, long-range transport and anthropogenic nonpoint source loads will be distinguished from each other.

Policy objective

The rule on Establishing a TMDL explains the steps that need to be taken to establish TMDLs as well as what elements are required in a TMDL. The revision is intended to clarify what sources could be given load allocations in a TMDL.

Policy evaluation

Advantages and disadvantages

This revision clarifies the EQC's intent on addressing sources of pollution by assigning load allocations as needed.

Summary of RWG discussion and views

The rulemaking workgroup discussed this issue at several meetings. *[RWG, please provide additional comments if your view is not reflected in this section]*

- The workgroup members have expressed the importance of addressing air sources and their support for being explicit about the department's authority to regulate air sources through TMDLs.
- Other members have expressed their concerns about lack of detail as to how air sources will be regulated to meet load allocations. The department provided the following summary as a potential approach to respond to a TMDL.

  If in the course of the TMDL process deposition of the pollutant of concern from the air is identified as a contributor to the water quality violation, the air program will be notified and provided with a load allocation for air sources. The air program will approach this situation much as it would for a violation of an ambient air quality standard. An inventory of sources within the physical boundaries of the study area that are emitting that pollutant will be determined. An air quality dispersion model will use that inventory, along with appropriate meteorology, physical and chemical characteristics of the pollutant, and other factors to quantify deposition within the study area. The contribution of each air permitted source, as well as non-permitted stationary and mobile sources, to the total deposition will be estimated. Regional and global contributions will be estimated as well. The air program will then work with the water program to identify emissions reduction strategies to meet the load allocation.

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- Some members of the workgroup raised the possibility that if air sources are identified as a source in TMDLs, the air sources may be forced to fund air modeling associated with TMDLs to differentiate nearby depositions and long range transport.

Authority and precedence

Under current Division 42 TMDL rules the department has the authority to assign load allocations to air sources.

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Relevant Statutes and Administrative Rules

Forestry

527.765 Best management practices to maintain water quality; rules.

(1) The State Board of Forestry shall establish best management practices and other rules applying to forest practices as necessary to insure that to the maximum extent practicable nonpoint source discharges of pollutants resulting from forest operations on forestlands do not impair the achievement and maintenance of water quality standards established by the Environmental Quality Commission for the waters of the state. Such best management practices shall consist of forest practices rules adopted to prevent or reduce pollution of waters of the state. Factors to be considered by the board in establishing best management practices shall include, where applicable, but not be limited to:

(a) Beneficial uses of waters potentially impacted;

(b) The effects of past forest practices on beneficial uses of water;

(c) Appropriate practices employed by other forest managers;

(d) Technical, economic and institutional feasibility; and

(e) Natural variations in geomorphology and hydrology.

(2) The board shall consult with the Environmental Quality Commission in adoption and review of best management practices and other rules to address nonpoint source discharges of pollutants resulting from forest operations on forestlands.

(3)(a) Notwithstanding ORS 183.310 (8), upon written petition for rulemaking under ORS 183.390 of any interested person or agency, the board shall review the best management practices adopted pursuant to this section. In addition to all other requirements of law, the petition must allege with reasonable specificity that nonpoint source discharges of pollutants resulting from forest operations being conducted in accordance with the best management practices are a significant contributor to violations of such standards.

(b) Except as provided in paragraph (c) of this subsection, if the board determines that forest operations being conducted in accordance with the best management practices are neither significantly responsible for particular water quality standards not being met nor are a significant contributor to violations of such standards, the board shall issue an order dismissing the petition.

(c) If the petition for review of best management practices is made by the Environmental Quality Commission, the board shall not terminate the review without the concurrence of the commission, unless the board commences rulemaking in accordance with paragraph (e) of this subsection.

(d) If a petition for review is dismissed, upon conclusion of the review, the board shall issue an order that includes findings regarding specific allegations in the petition and shall state the board's reasons for any conclusions to the contrary.

(e) If, pursuant to review, the board determines that best management practices should be reviewed, the board shall commence rulemaking proceedings for that purpose. Rules specifying the revised best management practices must be adopted not later than two years from the filing date of the petition for review unless the board, with concurrence of the Environmental Quality Commission, finds that special circumstances require additional time.

(f) Notwithstanding the time limitation established in paragraph (e) of this subsection, at the request of the Environmental Quality Commission, the board shall take action as quickly as practicable to prevent significant damage to beneficial uses identified by the commission while the board is revising its best management practices and rules as provided for in this section. [1991 c.919 §20; 2003 c.75 §95; 2003 c.749 §11]

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527.770 Good faith compliance with best management practices not violation of water quality standards; subsequent enforcement of standards. A forest operator conducting, or in good faith proposing to conduct, operations in accordance with best management practices currently in effect shall not be considered in violation of any water quality standards. When the State Board of Forestry adopts new best management practices and other rules applying to forest operations, such rules shall apply to all current or proposed forest operations upon their effective dates. However, nothing in this section prevents enforcement of water quality standards against a forest operator conducting operations after the time provided in ORS 527.765 (3)(e) for adoption of revised best management practices if the board either has not adopted revised management practices or has not made a finding that such revised best management practices are not required. [1991 c.919 §21; 2003 c.749 §12]

Agriculture

ORS Chapter 568 — Soil and Water Conservation; Water Quality Management

568.930 Agricultural activities subject to plan requirements; consultation with Environmental Quality Commission; review and revision of plans.

(1) Landowners shall conduct all agricultural activities on agricultural lands within the boundaries of an area subject to a water quality management plan in full compliance with the rules implementing the plan and with all the rules and standards of the Environmental Quality Commission relating to water pollution control. In addition to any other remedy provided by law, any violation of those rules or standards shall be subject to all remedies and sanctions available to the Department of Environmental Quality or the Environmental Quality Commission.

(2) The State Department of Agriculture and the State Board of Agriculture shall consult with the Department of Environmental Quality or the Environmental Quality Commission in the adoption and review of water quality management plans and in the adoption of rules to implement the plans.

(3)(a) The Environmental Quality Commission may petition the State Department of Agriculture for a review of part or all of any water quality management plan and rules implementing the plan. The petition must allege with reasonable specificity that the plan or the rules are not adequate to achieve compliance with applicable state and federal water quality standards.

(b) The State Department of Agriculture, in consultation with the State Board of Agriculture, shall complete its review of a petition submitted under paragraph (a) of this subsection within 90 days of the date of the filing of the petition for review. The State Department of Agriculture may not terminate the review without the concurrence of the Environmental Quality Commission unless the department initiates revisions to the rules implementing the water quality management plan that address the issues raised by the Environmental Quality Commission. If the State Department of Agriculture adopts any revisions in response to a petition by the Environmental Quality Commission, the department shall adopt the revisions not later than two years from the date the Environmental Quality Commission submits the petition, unless the department, with the concurrence of the Environmental Quality Commission, finds that special circumstances require additional time.

(4) A water quality management plan and rules implementing the plan that pertain to a ground water management area shall be subject to the coordination requirements of ORS 468B.162. [1993 c.263 §13; 1999 c.59 §179; 2001 c.594 §6]

561.191 Program and rules relating to water quality.

(1) The State Department of Agriculture shall develop and implement any program or rules that directly regulate farming practices, as defined in ORS 30.930, that are for the purpose of protecting water

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quality and that are applicable to areas of the state designated as exclusive farm use zones under ORS 215.203 or other agricultural lands in Oregon, including but not limited to rules related to:

(a) Protection of the quality of surface or ground water;
(b) Wellhead protection areas;
(c) Coastal zone management areas;
(d) Areas of ground water concern; and
(e) Ground water management areas.

(2) Any program or rules adopted by the State Department of Agriculture under subsection (1) of this section shall be designed to assure achievement and maintenance of water quality standards adopted by the Environmental Quality Commission.

(3) If two or more state agencies are required to adopt rules under ORS 468B.150 to 468B.190, the agencies:

(a) Shall consult with one another and coordinate the rules; and
(b) May consolidate the rulemaking proceedings.

(4) Nothing in this section is intended to change or reduce the authority of the Water Resources Commission or the Water Resources Department under ORS chapters 536 to 543. [1995 c.690 §6a]

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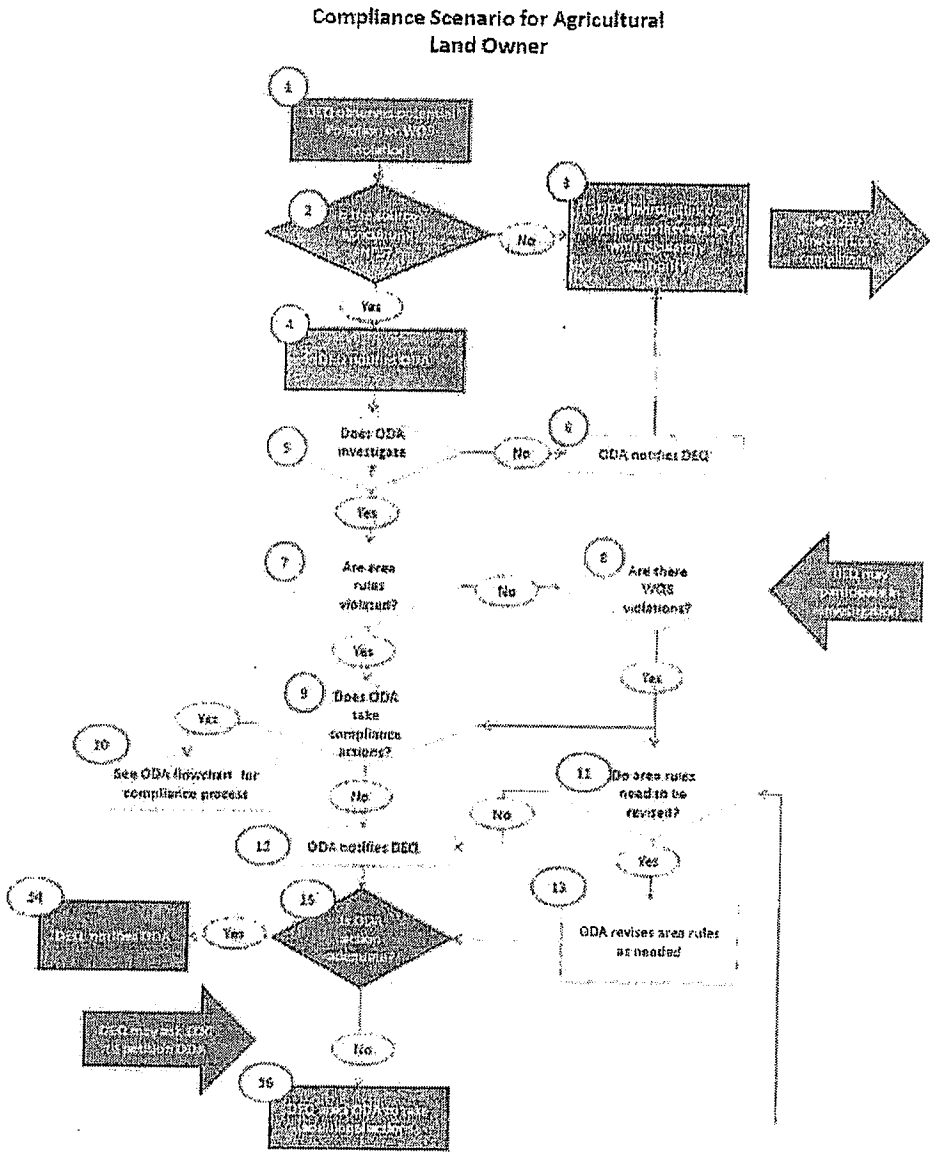
Draft Flow Chart – Under review by DEQ Management and State Agencies



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DRAFT
NOV 18, 2010

Oregon's Integrated Water Resources Strategy

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UMATILLA COUNTY
PLANNING DEPARTMENT

Water Resources Commission

A statewide integrated water resources strategy will bring various sectors and interests together to work toward the common purpose of maintaining healthy water resources to meet the needs of Oregonians and Oregon's environment for generations to come.

Policy Advisory Group

Everywhere in our State, we see healthy waters, able to sustain a healthy economy, environment, and cultures & communities. *Healthy waters*...are abundant and clean. A *healthy economy*...is a diverse and balanced economy, nurturing and employing the State's natural resources and human capital to meet evolving local and global needs, including a desirable quality of life in urban and rural areas. A *healthy environment*...includes fully functioning ecosystems, including headwaters, river systems, wetlands, forests, floodplains, estuaries, and aquifers. *Healthy cultures and communities*... depend on adequate and reliable water supplies to sustain public health, safety, nourishment, recreation, sport, and other quality of life needs.

Goal 1 — Improve Understanding of Oregon's Water Resources

Objectives 1 & 2 — Understand both Instream and Out-of-Stream Needs

Critical Issues

- Out-of-Stream Demands for Water Projected to Increase
- Instream Needs Not Well Defined *(e.g., water quality, ecosystem, flow needs)*

Guiding Principles

Integration, Balance, Informed Decision-Making, Collaboration, Flexibility, Partnerships, Incentives, Statewide Facilitation, Local Capacity, Practicality, Streamlining, Prioritization, Leveraged Resources, Transparent Process, Consider Costs-to-Benefits, Equity, Science-Based

Recommended Actions

To Be Determined...

Objective 3 — Understand Water Resources Today

Critical Issues

- Limited Supply of Clean & Abundant Water
- Inadequate Water Quality & Water Quantity Data
- Limitations/Inefficiencies in Water Quality & Quantity Management

Guiding Principles

Integration, Balance, Informed Decision-Making, Collaboration, Flexibility, Partnerships, Incentives, Statewide Facilitation, Local Capacity, Practicality, Streamlining, Prioritization, Leveraged Resources, Transparent Process, Consider Costs-to-Benefits, Equity, Science-Based

Recommended Actions

To Be Determined...

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Goal 1 — Improve Understanding of Oregon's Water Resources

Objectives 4 & 5 — **Understand the Coming Pressures That Affect Our Needs and Supplies**

Critical Issues

- Water & Energy Nexus Not Adequately Addressed
- Climate Change Represents Departure from Historic Conditions
- Population Growth Predicted
- Economic Development Necessary
- Land Use and Water Not Well Aligned
- Damaged Aquatic Ecosystems *(including invasive species)*
- Deteriorating Infrastructure
- Pollutants that Affect Water Quality

Guiding Principles

Integration, Balance, Informed Decision-Making, Collaboration, Flexibility, Partnerships, Incentives, Statewide Facilitation, Local Capacity, Practicality, Streamlining, Prioritization, Leveraged Resources, Transparent Process, Consider Costs-to-Benefits, Equity, Science-Based

Recommended Actions

To Be Determined...

Goal 2 — Meet Oregon's Water Resource Needs

Objectives 6 & 7 — **Meet Oregon's Instream and Out-of-Stream Needs**

Critical Issues

- Inadequate Institutional Capacity *(agencies, tribes, partners)*
- Barriers to Instream Flow Protections
- Barriers to Water Quality Protection
- Deteriorating Natural Storage Systems
- Barriers to Water Supply & Economic Development
- Inadequate Education and Outreach
- Barriers to Water-Use Efficiency
- Funding Necessary for Recommended Actions

Guiding Principles

Integration, Balance, Informed Decision-Making, Collaboration, Flexibility, Partnerships, Incentives, Statewide Facilitation, Local Capacity, Practicality, Streamlining, Prioritization, Leveraged Resources, Transparent Process, Consider Costs-to-Benefits, Equity, Science-Based

Recommended Actions

To Be Determined...

Next Steps to Implementation

An iterative process will help us evaluate whether the recommended actions meet the goals and objectives defined above. The process will include monitoring the implementation of recommended actions, a commitment to resolving conflicts that arise during the course of implementation, providing feedback on any successes or shortcomings, and evolving or adapting to new information or resources. As we learn lessons from the first round of implementation, we can adjust the Strategy as needed through formal adoption every five years.

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Oregon's Integrated Water Resources Strategy
Issue Papers

November 18, 2010
Version Two

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Forward

During Summer 2009, four Water Resources Commissioners—Mary Meloy, Jeanne LeJeune, John Jackson, and John Roberts—took the lead researching and writing seven "issue papers" to set the stage for Oregon's Integrated Water Resources Strategy. These papers are designed to convey the urgency of planning for the future of Oregon's water resources. The papers cover several topics from an Oregon perspective, and serve as the "problem statement" portion of the Integrated Water Resources Strategy.

The first version of the issue papers were released for public comment in late 2009. Comments and suggestions based on this version were very detailed and helpful, resulting in entirely new essays, such as "Federal Storage," "Land-Use Decisions," "Groundwater – Surface Water Relationship," and more. As you review this second version of papers, please let us know whether you believe your input is accurately reflected herein.

The Project Team made every effort to incorporate as many suggestions or changes as possible. However, more work is needed to fully develop certain concepts or issues. Sections that need more discussion are highlighted throughout the papers. We anticipate developing four versions of these papers, and welcome any help to expand on existing concepts or to add new discussions.

These papers are open to public review and comment until March 1, 2011. The Project Team welcomes your input and invites you to send any written comments you care to make to waterstrategy@wrd.state.or.us, with "Issue Paper Comments" in the title of the email. Please include your name and contact information, and indicate if you do not want your comments to be made public. We appreciate your interest and encourage your involvement as we move forward.

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Introduction: the Need for an Integrated Water Resources Strategy

"A problem well stated is a problem half solved."
Charles F. Kettering

Oregon currently has no formal water management strategy. It is one of many states without an integrated strategy that takes into account water quantity, water quality, and ecosystem needs. An integrated water resources strategy is needed as we develop a vision of what Oregon's livability and economic viability will look like for future generations. While no two communities are identical, they all have similar hydrologic elements, such as river systems, aquifers, springs, and ecosystems. They have other similarities too, including a need to coordinate with neighbors, a need for local solutions to local challenges, and a need for funding. An integrated strategy will provide relevant and consistent guidance to Oregon communities. Implementation of such a strategy should consistently move Oregon toward the preservation, restoration, and development that is necessary to achieve the desired vision of healthy waters everywhere in Oregon.

The state's statutory mandate is to develop a strategy designed to meet Oregon's instream and out-of-stream needs. This language, included in HB 3369 (2009), is a refinement of an already existing mandate to formulate and enforce a coordinated, integrated state water resources policy, designed to encourage, promote, and secure the maximum beneficial use and control of such water resources and the development of new supply. In statute (ORS 536.220), the Legislature directs Oregon's Water Resources Department to work closely with the Oregon Department of Environmental Quality and Oregon Department of Fish and Wildlife to develop the strategy in consultation with other agencies, tribes, stakeholders, and the public. The Strategy is to be an "action" plan for the state now and into the future. For the full text of ORS 536.220, as well as details about process and timeline, please refer to the *Preliminary 2009-12 Work Plan: Oregon's Integrated Water Resources Strategy*.

A Limited Supply of Clean and Abundant Water

Although water supply is considered a renewable resource, in a very practical sense it is a finite resource, further limited by water quality, geographic location, and transport costs. Many of Oregon's built communities, along with Oregon's fish and wildlife, face water scarcity today. Most of the state's surface waters are fully allocated during summer months, and there are several areas where groundwater use is severely limited by supply problems or quality issues. These pressures will likely be intensified by population growth, changes in land use, and climate change.

The degradation of groundwater and surface water quality also decreases the volume of fresh water immediately available to water users and the environment. Freshwater bodies have limited capacity to process the pollutant load from urban, industrial, and agricultural uses. Low stream flows can often mean a greater concentration of pollutants in the water. Water quality degradation often contributes water scarcity.

Without a better understanding and a plan to meet our water needs in a balanced way, Oregonians will likely cross a water scarcity boundary without even knowing it. Recognizing the inextricable link between water quantity and water quality is inherent to the success of this strategy.

The Value of a Strategy

An integrated strategy will provide a blueprint for the state to follow as it prepares to meet Oregon's water needs: instream and out-of-stream; above ground and below ground; now and in the future.

Water is an important component of everything we do in Oregon. The state's industrial and commercial sectors, agriculture, recreation, tourism, electric power, navigation, and residential uses are all dependent on reliable, clean water. Oregon's fish and wildlife depend on clean and abundant water and healthy habitats,

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which is supported by functioning and resilient watersheds, wetlands, floodplains, aquifers, lakes, estuaries, and the ocean. Water has incredible value, meaning, and use for many communities, including tribal, agricultural, rural, urban, and coastal communities. Clean and reliable water supplies also ensures the ability to protect public health through safe drinking water, and to protect public safety through fire suppression.

In addition to a focus on the water resource itself, the Strategy presents an opportunity to discuss and assess the infrastructure that diverts, stores, treats, and transports significant volumes of water throughout Oregon. Well-maintained and adequate infrastructure is critical for ensuring the economic, ecological, and cultural benefits mentioned above.

This Integrated Water Resources Strategy will serve several purposes. It will:

- encourage planning at a watershed or basin level, providing a framework for local communities to facilitate and complete their own integrated water management planning;
- balance competing uses of water, by paying attention to environmental costs and benefits, economic impacts, societal values, and trade-offs;
- promote water conservation, water re-use, source protection, and supply development to enhance water quality and quantity;
- encourage participation of all units of government, stakeholders, tribes, and the public;
- provide a framework for local communities to facilitate and complete their own integrated water management planning;
- foster public health and safety; and
- address existing institutional barriers that reduce the ability to effectively manage water resources.

Building on a Foundation of Data

The Strategy benefits from the participation of 14 natural resource and economic development agencies at the state level and another 10 agencies at the federal level. An appendix that outlines the management of water resources among these various agencies is currently in development and will be included in a later version of the issue papers. This "Agency Appendix" will provide more information about the data, tools, and programs currently available through Oregon's natural resource agencies and will help identify opportunities for agencies to jointly develop data on an ongoing basis.

The public and private sectors at the local, state, and federal levels have produced a plethora of plans and studies focused on water quantity, water quality, and other water-related issues from environmental, business, socio-economic, hydrological, and geological perspectives. For instance, municipal water providers and irrigation districts maintain water use data and water demand forecasts, in order to plan and fund water supply and distribution to their service territories. The Water Resources Department has begun to pull this collection of data into a centralized, usable format, through an on-line inventory of potential storage sites, potential conservation programs, and a 50-year water demand forecast. In addition, the Department has made many of its quantitative tools available on-line. However, a wide variety of methodologies, formats, and geographic coverage often makes it difficult to compile and analyze this data at the state level. This Strategy may provide an opportunity for further discussion about standardization and information sharing as a way to build upon the existing information as well as collect new information to help determine Oregon's long-term water needs.

Developing a Strategy through Collaboration

The Water Resources Commission has statutory authority to review and adopt the Integrated Water Resources Strategy, with the Water Resources Department leading the development efforts. An essential part of the Strategy is the collaborative process of building the plan. Water is a subject in which everyone is a stakeholder and must be given an opportunity to participate in and shape the process. A participatory approach is an effective means for achieving consensus and long-lasting agreement. Real collaboration takes place only when stakeholders and the interested public are part of the decision-making process. Incorporating the views of a wide variety of governmental agencies, stakeholders, and the public will be a challenge, but is key to the success of such a Strategy.

At the end of the process, the Water Resources Commission will be responsible for formal adoption of the Strategy, having notified the Environmental Quality Commission, Fish and Wildlife Commission, and Department of Agriculture/Board of Agriculture.

Conclusion

A successful Strategy would result in a persuasive visualization of what Oregon's water and landscape should look like and be like for future generations. This Strategy will provide a framework for future efforts in terms of data collection, information sharing, program development, funding mechanisms, and education and outreach opportunities. It will include a vision for the future of water resources with goals, objectives, and recommended actions to implement a desired outcome. With updates every five years, the Strategy can be adapted or adjusted as better information becomes available, helping Oregon to stay on course with the goals identified. It will necessarily touch upon a wide spectrum of water resource issues and actions that will help the state meet the goal of better understanding and meeting Oregon's water needs.

Sources

Oregon Department of Conservation and Land Development, *Oregon Estuary Plan Book*. 1987.

Oregon Water Resources Department, *Taking a Look at Oregon's Water*. WRD Infosheet No. 5. March 2007.

Oregon Water Resources Department. *A Report by the Water Quality Quantity Task Force*. February 1997.

Water Quantity

Understanding water needs, sources of supply, and available water are necessary building blocks for developing a statewide, integrated water resources strategy. The purpose of this paper is to describe, in general terms, the context and current understanding of water quantity in Oregon for all beneficial uses, and the need to constantly improve upon this understanding. The paper briefly highlights the issues many Oregonians are facing, in terms of meeting their water needs. Further information related to data and technical information requirements, research needs, goals and objectives, and potential solutions will be addressed in future developmental steps of Oregon's Integrated Water Resources Strategy.

Water Rights

Under Oregon law, all water is publicly owned. Any entity wanting to use water must obtain a water right permit from the Water Resources Department to appropriate groundwater, store water, or divert from surface water. Landowners with water flowing past, through, or under their property do not automatically have the right to use that water without a permit from the Department. However, certain uses of surface water, storage, and groundwater are exempt from permitting requirements. These exempt uses are described in Oregon Revise Statute (ORS) Chapter 537.

Any water right to use water must serve a beneficial purpose. A beneficial use of water promotes the economic and general welfare of the people of the state and includes both consumptive and non-consumptive uses from surface water, groundwater, and storage. Such uses include:

- Domestic
- Industrial
- Mining
- Pollution Abatement
- Recreation
- Wildlife
- Fish Life
- Irrigation
- Municipal
- Power Development
- Livestock Watering

The major uses of diverted water in Oregon are for municipal use, industrial use and irrigation use. Irrigation for agricultural purposes currently accounts for 85 percent of water diverted in Oregon. Municipal use accounts for 6 percent of diverted water, as does industrial use.

Demands for Water Projected to Increase

Oregon's municipal, business and agricultural communities, along with Oregon's fish and wildlife, are already facing limited water supplies today. Surface water is almost completely allocated during the summer months, when it is needed most. As we rely increasingly on our groundwater resources, water levels have dropped precipitously in some areas. The state has designated critical groundwater areas in the Umatilla Basin, Willamette Valley, and in parts of Central and Eastern Oregon. Population growth, changes in Oregon's climate, and land use changes will challenge our ability to meet our water needs. Without solutions in place, water supply shortages will likely increase in future years.

Prior Appropriation Doctrine

Oregon's water laws are based on the principle of prior appropriation. This means the first person to obtain a water right on a stream is the last to be shut off in times of shortage. In water-short times, the water right holder with the oldest date of priority can demand the water specified in their water right regardless of the needs of junior users. If there is a surplus beyond the needs of the senior right holder, the water right holder with the next oldest priority date can satisfy their needs under their right and so on down the line until there is no surplus or until all rights are satisfied. The date of application for a permit to use water usually becomes the priority date of the right.

The prior appropriation doctrine is the basis of water law for most of the states west of the Mississippi River. East of the Mississippi, the riparian doctrine usually applies. Under the riparian doctrine, only landowners with water flowing through their property have claims to the water. In Oregon, the prior appropriation doctrine has been law since February 24, 1909, when passage of the first unified water code introduced state control over the right to use water. Before then, water users had to depend on themselves or local courts to defend their rights to water.

Each summer as streamflows drop, watermasters regulate junior users of water in order to provide water to senior users and to protect instream uses. There are times when the Water Resources Department must regulate water uses established at the turn of the century as a means to satisfy senior rights. In 2009, for example, the earliest priority date regulated was 1857 on the Little Applegate River in the Rogue Basin.

In 2008, the state commissioned a water demand forecast to estimate demands out to year 2050. According to the *Statewide Water Needs Assessment,* total demand will increase 12.6 percent over the next 40 years, from 9.1 million acre feet to 10.3 million acre feet per year. With the influx of population, the study projects that municipal demand could increase 55 percent, domestic demand (exempt well use) could increase 57 percent, industrial demand will likely remain static, and agricultural demand could increase 10 percent. For more information about the methodology used in Oregon's 2008 water demand forecast, view the *Statewide Water Needs Assessment: Oregon Water Supply and Conservation Initiative* online.

The 2008 demand forecast calculated Oregon's 2008 total statewide consumptive demand at approximately 9.1 million acre feet, and projected that in 2050, the total could increase to about 10.3 million acre-feet, based on projected growth in the municipal, domestic, industrial, and agricultural sectors. Given the many uncertainties, the results actually show a range of demands, between 9.5 and 11 million acre feet for out-of-stream demand.

Figure 1 shows the breakdown of demand by water-use sector. Note that demand for water is projected to rise across all sectors, between now and 2050. Agricultural use for irrigation purposes represents and will likely continue to represent the greatest demand of diverted water in Oregon. The greatest increase in the agricultural sector will likely come from Baker, Gilliam, Grant, Harney, Morrow, Sherman, and Umatilla Counties. The greatest increase in the municipal sector will likely come from Clackamas, Deschutes, Josephine, Lincoln, Polk, Washington, and Yamhill Counties.

Figure 1: Annual Statewide Water Demand Forecast in Acre-Feet

Years	Municipal Systems	Domestic Wells	Industrial	Agricultural	Total
2010	559,123	83,242	533,622	7,880,804	9,056,791
2015	595,570	88,750	533,622	7,983,558	9,201,500
2020	634,641	94,600	535,084	8,088,667	9,352,992
2025	671,637	100,215	533,622	8,196,188	9,501,661
2030	709,440	105,917	533,622	8,306,180	9,655,160
2035	746,890	111,610	533,622	8,418,704	9,810,826
2040	786,675	117,749	535,084	8,533,822	9,973,330
2045	825,817	123,870	533,622	8,651,597	10,134,907
2050	868,885	130,566	533,622	8,772,096	10,305,170

Surface Water

There are 18 river basins in Oregon. Oregon shares three major rivers with other states, the Columbia, Snake, and Klamath Rivers. There are 114,500 miles of rivers and streams, with over 1,400 named lakes. Most of the state's surface waters are fully allocated during the summer months. Over 60 percent of the water rights are for use of surface water.

Surface Water Measurement. The Water Resources Department operates more than 213 stream and reservoir gages throughout the state. About 150 of these gages are operated as near real-time. These gages transmit stream data once every hour. This data is downloaded to the Department's database where it is processed and the streamflow information is updated on the web page on an hourly basis. In addition, information from another 225 gages operated by the U.S. Geological Survey and other agencies is also shared on the Department's website.

The network of stream gages is important in the management of Oregon's surface water. Stream flow data is used for making daily decisions, to protect instream and out-of stream water rights, to forecast floods, plan for recreational activities, to better understand water availability, climate change and plan for future growth. Operating a stream gage network requires trained hydrographic technicians to keep the equipment operating properly, conduct regular measurements at various water elevations, and input the collected information into a central database. Staff review the data, make corrections based on field conditions that may be affected by debris or ice, and finalize the records to meet computation standards established by the USGS. Currently, the state lacks sufficient financial resources to install, maintain, and process data from additional stream gages.



Figure 2: OWRD Gaging Stations

Determining Surface Water Availability. In 1989, the Water Resources Commission directed the Water Resources Department to develop a water allocation policy and to establish a water availability program. The Department developed methodology and data to determine water availability in the context of allocating new water rights. This allocation tool ensures that a new user will be able to use surface water at least 80 percent of the time, or 8 out of every 10 years. The amount of water available for use is affected by natural conditions, such as hydrology and climate, and existing uses of water, including groundwater withdrawals that impact surface water. **Figure 3** shows where water is available for live flow allocation during the month of August, the month most representative of low summer flows and high out-of-stream demands. With some exceptions, the map indicates that throughout the state very little water is available for new direct surface water uses.

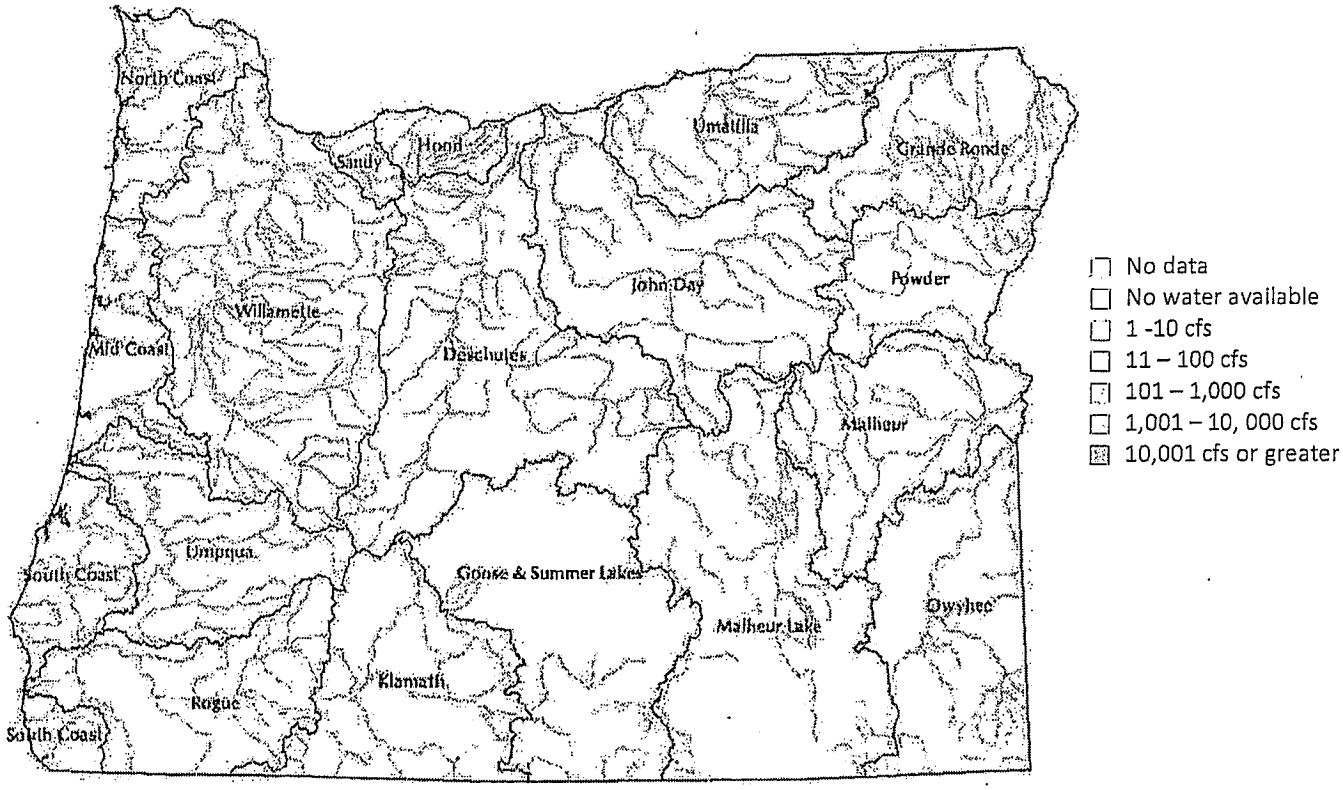

Figure 3: Water Availability for August at 80% Exceedance

By contrast, the map in **Figure 4** shows where water is currently available for allocation during January (the month most representative of higher winter flows and less out-of-stream demand). The map indicates in brown where no water is available, mostly east of the Cascades, but there is a large part of the state where water is available for instream or out-of-stream uses during the winter, denoted in blue.

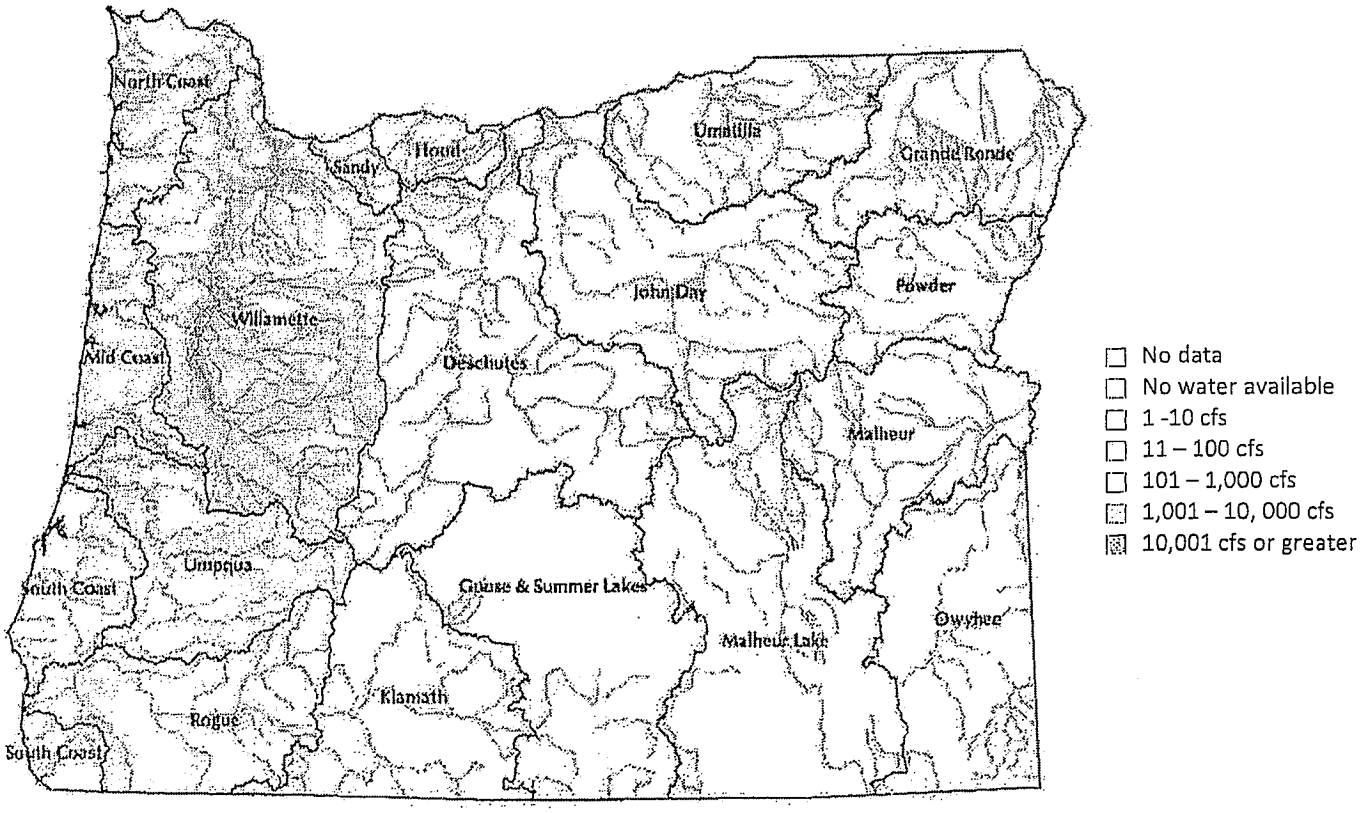

Figure 4: Water Availability for January at 50% Exceedance

Water is a finite resource. It is unevenly distributed in time – plenty of water in the winter when demand is low, little available in the summer when demand is high. Even with a water right in hand, there is no 100 percent guarantee that water will be available when it is needed. For many streams, a new water right would offer little or no access to water, such as in the Malheur, Burnt, and Powder Rivers. If water use increases, more streams will have water available less of the time. The information, tools, and maps in these issue papers represent the baseline data and assumptions available to us today. Changing conditions, including climate, population growth, land-use, and other factors will undoubtedly have an effect on the understanding of water resources in the years ahead.

Storage

There is a mix of both publicly and privately owned storage reservoirs in use throughout Oregon. The largest of these are federal storage projects. There are four significant reservoir systems that are not fully allocated, representing key points of discussion between the state and two federal agencies, the U.S. Army Corps of Engineers (Corps) and the U.S. Bureau of Reclamation (Bureau). In the Rogue Basin and Umatilla Basin, federally owned reservoirs contain available water supplies with solid processes already in place to negotiate contracts for stored water. However, in the Crooked River Basin and the Willamette Basin, it is difficult to secure contracts for unallocated water. Along with options for future out-of-stream allocations, there may be opportunities to adjust dam management in a way that would allow for additional instream flows at critical times.

The Willamette Basin Reservoir System. The Corps operates 13 dams and stores 1.64 million acre-feet of water in the reservoirs located on the Willamette River and its tributaries. Congress authorized the construction of these reservoirs for different purposes, including flood control, navigation, generation of hydroelectric power, irrigation, potable water supply, and for the reduction of stream pollution in the interests of public health, fish conservation and public recreation. In addition, the Corps works with appropriate agencies and groups to determine operating procedures of the reservoirs during the summer months. This coordination helps to maximize recreational use, while maintaining flows in the system at Salem and Albany for water quality, fisheries, and other instream purposes.

Despite the many purposes for which the reservoir projects were authorized, the Bureau filed water right applications (and later received water right certificates) for the entire 1.6 million acre-feet of storage, for irrigation use only. To date, the Corps has not allocated any storage in the Willamette Basin Project reservoirs to for other uses.

The State of Oregon and the Corps recognize that economic development and population growth are creating new demands on water supplies in the Willamette Basin. In 1996, state and federal agencies initiated the Willamette Basin Reservoir Study to analyze water use, project water demand for a variety of uses in the basin, and identify ways to allocate reservoir water to assure the most public benefit within the policies and regulations of the Corps. The Reservoir Study was "put on hold" in 2000 following listing of certain Willamette River fish species under the Endangered Species Act (ESA). The partners in the Reservoir Study agreed that long-term decisions regarding allocation of stored water could not be completed until requirements for listed species were clarified. The ESA consultation process was completed and a Biological Opinion (BiOp) was issued in August 2008.

The 2008 BiOp for the Willamette Basin Project, conducted by the National Oceanic and Atmospheric Administration (NOAA) - Fisheries Service, specified a number of restrictions that will be in place during the 15-year period of the BiOp. These restrictions affect existing irrigation contracts, as well as new contracts for the use of stored water from the Willamette Basin Project reservoirs. The restrictions limit the total amount of stored water that can be provided under existing and new irrigation contracts to 95,000 acre-feet. By comparison, the U.S. Army Corps of Engineers, which manages the Willamette Basin reservoirs, and the U.S.

Bureau of Reclamation, which manages the stored water contracts in these reservoirs have long indicated that there is approximately 1.6 million acre-feet of stored water available for contracts from the Willamette Basin Project. The Water Resources Department continues to discuss these restrictions and potential opportunities with various partners and stakeholders.

Groundwater

Because of increasingly allocated surface water quantities, water users have become heavily reliant upon groundwater resources to meet their needs. This increased pressure, along with other factors, has resulted in the depletion of groundwater levels in several areas of the state. In many instances, applicants for new groundwater appropriations are proposing use from groundwater aquifers that are hydraulically connected to surface water.

Groundwater in Oregon has many valuable uses and functions:

- Groundwater makes up approximately 95 percent of available freshwater resources.
- Approximately 70 percent of all Oregon residents rely solely or in part on groundwater for drinking water purposes.
- More than 90 percent of rural Oregonians rely on groundwater for drinking water.
- Many Oregon businesses rely on clean groundwater for industrial uses, such as food processing, dairies, manufacturing, and computer chip production.
- Groundwater provides water for Oregon agricultural irrigation and livestock purposes.
- Groundwater contributes flow to lakes and streams, providing recreational benefits to humans and supporting species survival and diversity.

Groundwater Investigations. Oregon's groundwater basins roughly correspond with the administrative basins the Department uses to classify its surface water resources. Groundwater studies are iterative and ever evolving. The Water Resources Department generally begins any groundwater study with a "first pass" that develops a water budget for each basin, showing overall volumes of groundwater recharge, discharge, and available water. The Department has completed a "first pass" in three basins: the Deschutes, Klamath, and the Willamette basin. The Department plans to study the following basins as resources become available: the Umatilla Basin, together with its Walla Walla sub-basin; Hood Basin (Eight Mile/Fifteen Mile Creek); Upper Crooked River (High Plains Lavas); Grande Ronde Basin; Malheur Lake Basin; Powder Basin; and Goose and Summer Lakes Basin. As more questions arise or trends emerge (e.g., a focus on "climate change"), the Department updates studies and conducts a "second pass," asking and answering new sets of questions about each basin.

In an environment with limited fiscal resources, groundwater staff members spend a lot of time investigating very specific local questions from county planners, water users, and other local organizations. Additional and still more detailed work is often necessary to address these requests. This involves a somewhat different effort than the Department's traditional "groundwater studies" and represents a significant investment of time for staff. The Strategy could focus on developing partnerships with other state and federal entities that are working to identify and answer the same needs and questions

Restrictions on Groundwater Use – Quantity and Quality. The Water Resources Department has designated 14 *"groundwater limited areas"* in Oregon, 12 of which are located in the Willamette Valley alone. These designations, shown in orange in **Figure 5**, limit future use of certain aquifers to exempt uses of groundwater only. A few limited areas allow minimal irrigation use or withdrawal of groundwater for rural residential fire protection systems. Many of these areas have limited future groundwater uses since the early 1990's.

There are seven existing "critical groundwater areas," in Umatilla, Morrow, Wasco, Washington, and Malheur County. In several of these areas, the Water Resources Department has set specific requirements on the total amount of water that may be appropriated. In some of these critical areas, the Department has the authority to reduce groundwater use, even for existing water right holders. There are two "areas of withdrawal" in Oregon, the Pomona and Priest Rapids aquifers in the Mosier area of Wasco County and the Columbia River Basalt aquifer in the Victor Point area of Marion County. These withdrawn areas prevent any future development of the resource.

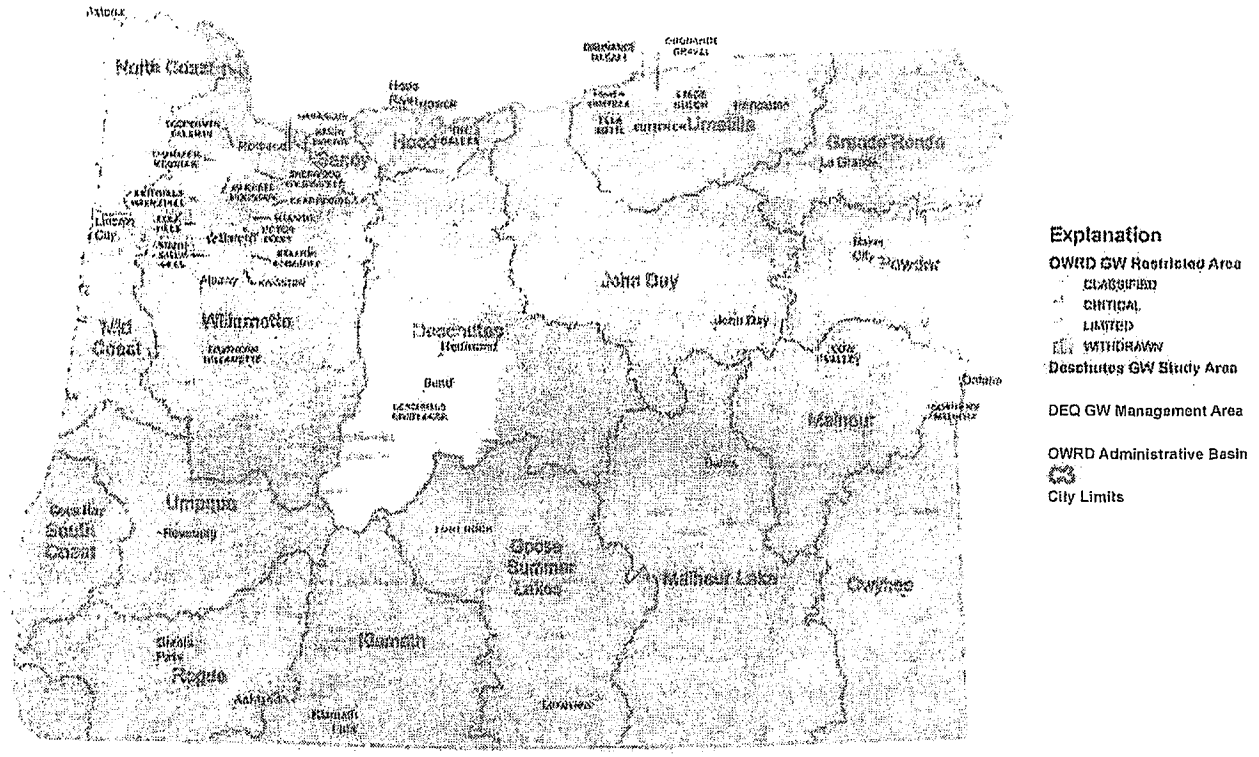

Figure 5: Groundwater Management Areas and Restrictions

The Department of Environmental Quality has authority to declare a groundwater management area (GWMA) when area-wide contamination is found at consistently high enough levels. Oregon has three such areas: the Northern Malheur County GWMA, the Lower Umatilla Basin GWMA, and the Southern Willamette Valley GWMA. DEQ declared all three GWMAs because of widespread nitrate contamination. DEQ is currently helping communities implement action plans that require groundwater quality monitoring, a review of existing data to assess groundwater quality trends, and to support local efforts that implement best management practices (BMPs) to maintain and restore groundwater quality.

All aquifers are susceptible to overdevelopment and contamination. The Columbia River Basalt formations, in particular, are of concern, because their hydrologic and geologic structure makes it easy to pull water out faster than the aquifer can naturally recharge itself. The Columbia River Basalts are deep aquifers, with ancient water that has seeped in over hundreds, if not thousands, of years.

Exempt Groundwater Use. Under Oregon law, "all water within the state from all sources of water supply belongs to the public." In general, a water right permit is required before using water from any well. However, there are exceptions called "exempt uses." These uses are exempt from applying for a water right permit, but must use water beneficially and without waste. Withdrawing groundwater under the exemption carries the same weight as a water right and does have a priority date. An exempt use is subject to the same privileges and restrictions as any water right permit or certificate. Exempt uses are subject to state water law.

In fact, the Department has the authority to regulate, reduce, or halt groundwater withdrawals when they interfere with prior or "senior" water rights.

Common exempt uses of groundwater include:

- Group or single domestic use, up to 15,000 gallons per day (gpd).
- Irrigation of lawn and/or non-commercial garden up to ½ acre.
- Single industrial or commercial purpose not to exceed 5,000 gpd.
- Irrigation of school property up to 10 acres in critical groundwater areas.
- Stock water.
- Down-hole heat exchange.

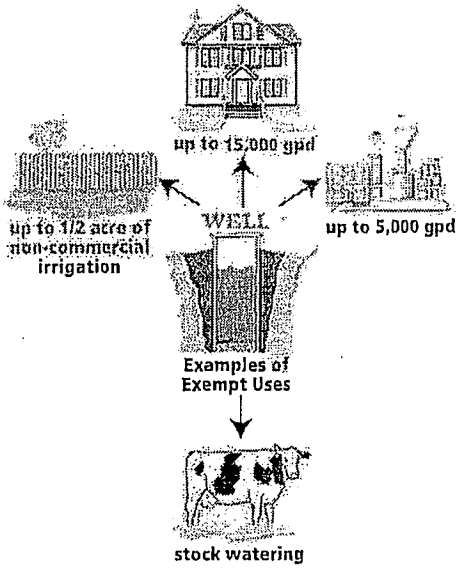

Figure 6: Exempt Groundwater Uses

Oregon has about 300,000 exempt-use wells, with approximately 3,800 drilled each year. The ever-increasing number of exempt use wells has resulted in calls for a closer policy look, including a better understanding of their demands on the resource, their potential for interference with senior water rights, and their overall effect on the health of Oregon's groundwater system. Currently, sufficient data to understand how these wells are affecting groundwater availability and surface water sources is lacking.

Groundwater Aquifer Storage and Recovery and Artificial Recharge. The statutes allowing Aquifer Storage and Recovery (ASR) were enacted in 1995. The ASR statutes allow water users to use existing water rights to store water in an aquifer and then recover that water for the beneficial use specified in the original water right. Initially, a limited license is required for ASR testing to determine if recovery of the water injected into an aquifer is feasible. The statutes for Artificial Groundwater Recharge (AR) were adopted in 1961, and separate permits are required first to appropriate and store water, and secondly, to recover and use the stored water.

In 2008, the Water Resources Department evaluated 54 aquifers within Oregon, creating a rating system of "geologic suitability for underground storage." This is an original methodology that helps assess the suitability of potential locations for underground storage. The Department evaluated aquifers in terms of their physical ability to store water. The analysis does not include an economic or environmental feasibility analysis, only a hydrogeologic evaluation of how these areas accept and retain water.

On the map below, the areas in green have the highest percent of "ideal" underground storage conditions, while the areas in red have the lowest. The red areas, indicating little storage potential, include Coast Range marine sediments, Western Cascade volcanics, and Klamath Mountain metamorphics, although there may be local exceptions. The green areas indicate areas with high storage potential, and include Columbia River basalts of the Northern Willamette Valley and the Columbia Basin. Other aquifer types with storage potential include volcaniclastic (pumice deposits in the Fort Rock Basin), as well as glacial and fluvial layers (west of Pendleton and throughout southeastern Oregon). The resulting summary map is shown here, and demonstrates the variability in physical storage potential across Oregon.

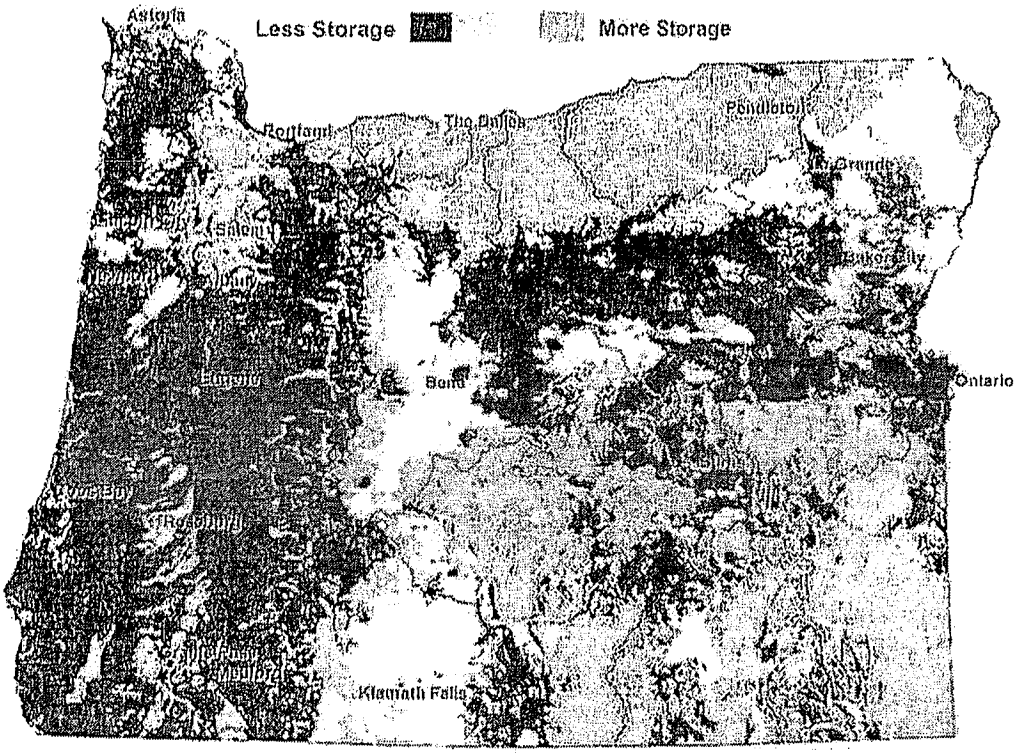

Figure 7: Geologic Suitability for Underground Storage

Communities interested in underground storage have to consider many factors. This storage tool will not be appropriate for every situation. Physical factors to investigate include the ability of the aquifer to accept water, its ability to retain water, and whether there is sufficient storage to reach an economy of scale. Cost/ benefit considerations play an equally important role in ASR and AR feasibility. Construction costs for underground storage are less than surface reservoirs, there are fewer environmental impacts, and there are minimal land requirements. However, site characterization and monitoring, water treatment, infrastructure improvements and ongoing maintenance and monitoring require significant investment.

Currently, about a dozen aquifer storage and recovery (ASR) projects and about half a dozen artificial recharge (AR) projects are authorized throughout Oregon. New projects are added each year as interest in this technology grows. Both municipal and agricultural water users are engaged in underground storage pilot projects and long-term projects as part of their water supply portfolios.

Currently, most ASR is conducted by municipalities and regional water suppliers. Salem, Beaverton, Tualatin, Tigard, Tualatin Valley Water District, Pendleton, Baker City, Clackamas River Water, Sunrise Water Authority, McNulty Water PUD, and Lafayette are implementing ASR. In addition, two agricultural ASR projects are operating in the Umatilla Basin for irrigation supply. AR projects are being conducted by agricultural entities for irrigation, domestic water associations for household use, and a watershed council for streamflow augmentation. County Line Water Improvement District, Buell-Red Prairie Domestic Water Association, Hudson Bay Irrigation District, Madison Farms, Walla Walla River Irrigation District, Deschutes Valley Water District and Avion Water Company are currently conducting AR projects.

The Umatilla Basin Water Commission is developing a plan to test regional AR and possibly ASR in the coming years. This project builds on the experience developed since 1977 at County Line Water Improvement District's recharge canal, and the feasibility study conducted in 2009 under SB 1069. The overarching goal is to augment groundwater supplies that have declined over time.

Conclusion

Nearly all of Oregon's surface water is fully allocated during the irrigation season. Opportunities for new groundwater uses are limited by hydrologic connection to fully appropriated surface water, declining water tables, or water quality issues. Although winter water may be available for storage projects, those opportunities may be limited by the need to protect peak and ecological flows, endangered species, or other environmental attributes. Lack of funding and agency resources are a key challenge to adequate water management in this state. There are many challenges ahead that limit our ability to meet Oregon's water needs. Not all of them can be addressed in the near term. As we develop the Strategy, it will be important to identify the most pressing issues facing our water resources.

Sources

Oregon Department of Environmental Quality. *Groundwater Protection in Oregon.* Portland, Oregon. January 2009.

"OWRD Strategic Outlook 2009-2011, Strategy 2 – Increase our understanding of the resource and the demands on it." Also, please note that the WRD water demand forecasts to 2050 by county and state are available through http://www.wrd.state.or.us/OWRD/LAW/owsci_info.shtml.

Oregon Water Resources Department. *Briefer: Stream Gaging in Oregon, Surface Water Data Collection.* May 2009. http://www1.wrd.state.or.us/pdfs/streamgage_info.pdf

Oregon Water Resources Department. Oregon Water Management Program. The Program establishes statewide policies and principles related to a wide range of water-related topics including storage and water allocation. These policy and principle documents can be found in Oregon Administrative Rules 690-400-000 through OAR 690-410-080.

Oregon Water Resources Department. *Oregon Water Supply and Conservation Initiative: Report to the 75th Legislative Assembly.* Salem, Oregon. January 30, 2009.

Oregon Water Resources Department. Results of a 2008 Oregon Water Supply and Conservation Initiative Grant: Southern Willamette Valley Municipal Water Providers. Staff Report. February 25, 2009.

Oregon Water Resources Department, U.S. Army Corps of Engineers. *Willamette Basin Reservoir Study: 2001 Update.* December 4, 2001.

Western Governor's Association. *Water Needs and Strategies for a Sustainable Future: Next Steps.* June 2008.

Winter, Thomas C. and Harvey, Judson W., et al. *Groundwater and Surface Water: A Single Resource.* U.S. Geological Survey 1139. Denver, Colorado. 1998

Water Quality

The purpose of this paper is to discuss the quality of Oregon's waters and how management of water quality and quantity interact. This paper describes some of the unintended consequences that occur when trying to manage water quality and water quantity separately. There are frequent conflicts when managing both quantity and quality and opportunities for improved coordination among agencies.

Background

Clean water is fundamental to protect our health, the environment, and our quality of life. We know that water is clean in Oregon when our surface water and groundwater meet the water quality goals that are set to protect beneficial uses. These goals are also known as water quality standards. Various pollutants degrade water quality and can enter the water through direct discharge pipes and by surface runoff from roads, lawns, and fields. Other variables, such as withdrawals of water and removal of streamside shade, can also have a detrimental physical or chemical effect on water quality.

Water quality and water quantity are unequivocally related. The choices we make in the management of water resources affect the balance between water quality and water quantity. For instance, protecting greater quantities of water instream has historically allowed Oregon to more easily satisfy state and federal water quality requirements. More water left instream helps dilute pollutant concentrations. If climate change, drought, increased demands, or other factors reduce the quantity of water in our watersheds, Oregon will have greater difficulty complying with state and federal water quality requirements to protect all of our beneficial uses.

Managing to Protect Water Quality

Water managers in Oregon operate in an institutional and regulatory environment that requires a high level of coordination and collaboration. Responsibility for protecting water quality resides at the federal level with the U.S. Environmental Protection Agency (EPA). The EPA approves water quality standards for each state. While each state has the ability to establish water quality standards, the states must be as strict, or more so, than the federal standards. There are two major federal laws governing water quality—the Clean Water Act and the Safe Drinking Water Act. The authority to implement and enforce these laws is delegated to the states. In Oregon, the Department of Human Services has authority to implement the Safe Drinking Water Act, which regulates the quality of drinking water delivered through community water systems. The Department of Environmental Quality (DEQ) has authority to implement the Clean Water Act, which regulates the water quality of streams, lakes, rivers, and estuaries. The Oregon Legislature has delegated responsibility for water quality protection on agricultural lands to the Oregon Department of Agriculture. The Oregon Department of Forestry regulates non-federal forests to protect water quality. In addition, local jurisdictions (counties and cities) are responsible for protecting water quality through comprehensive planning, stormwater management, and other regulatory programs.

The Department of Environmental Quality is also responsible for implementing various state laws to protect water quality, such as the Oregon Groundwater Quality Protection Act. The goals of the Act are to prevent contamination of groundwater resources, conserve and restore groundwater, and maintain the high quality of Oregon's groundwater resource for present and future uses. The Act also established a policy that all state agencies' rules and programs are to be consistent with this goal of protecting drinking water resources and public health.

Land use Management. With all of its implications for water resources, land-use management is a function that resides with local planners, local planning commissions, boards, and councils, all of which include a public process and oversight from the Department of Land Conservation and Development. These local governments

are responsible for implementing their own Comprehensive Land Use Plan that complies with 19 statewide planning goals, many of which are aimed at protecting water quality and quantity.

Goals that directly affect water include Goal 5 - Natural Resources, Scenic and Historic Areas, and Open Spaces, Goal 6 - Air, Water and Land Resources Quality, and Goal 11 - Public Facilities and Services, and are more specifically described below. Other goals do not directly address water but have an effect on, or are affected by, water quantity or quality.

Goal 5 and its administrative rules require local governments to protect, among other things, "significant natural resources." These include (1) critical groundwater areas and restrictively classified areas designated by the Oregon Water Resources Commission and (2) certain wellhead protection areas. Few local governments have completed the planning under Goal 5 for the former. Completing the Goal 5 process for wellhead protection areas is not mandatory. The Goal 5 provisions for protecting significant riparian corridors are partly there to protect surface water, particularly in urban areas. Goal 5 also has a requirement to protect wetlands.

Goal 6 is aimed at maintaining and improving the quality of the air, water, and land resources of the state. This goal has no implementing rules. Although the goal directs local governments to consider the effects of land use on water quality, it does not contain specific requirements on how to achieve this aim.

Goal 11 and its administrative rules require cities with a population greater than 2,500 to prepare public facilities plans addressing drinking water, wastewater disposal and treatment, and stormwater management needs. These plans focus on the costs and timing of infrastructure needs and coordination among providers within the jurisdiction.

The 19 Statewide Land Use Planning Goals

1. Citizen Involvement
2. Land Use Planning
3. Agricultural Lands
4. Forest Lands
5. Natural Resources, Scenic and Historic Areas, and Open Spaces
6. Air, Water and Land Resources Quality
7. Areas Subject to Natural Hazards
8. Recreational Needs
9. Economic Development
10. Housing
11. Public Facilities and Services
12. Transportation
13. Energy Conservation
14. Urbanization
15. Willamette River Greenway
16. Estuarine Resources
17. Coastal Shorelands
18. Beaches and Dunes
19. Ocean Resources

Each local government in Oregon with responsibility for land use management coordinates with various state agencies to ensure that state agency permitting actions are consistent with local comprehensive plans, including formal action on pending applications for water use and on-site sewage disposal systems. In cities, development is generally subject to design review that includes consideration of water quality through stormwater management. Drinking water quality and wastewater treatment are managed by public entities (the city or a district) in all but the smallest jurisdictions. In rural areas and cities that do not provide water and sewer service, the responsibility for addressing wastewater disposal belongs to the property owner, who is required to secure a permit from the Department of Environmental Quality or its agent to ensure wastewater is properly disposed.

Additionally, development on forestlands is limited by Goal 4 and county regulations. Forests encompass a large part of many of Oregon's watersheds, particularly in the upper reaches. Limiting land uses that could have a detrimental effect on water quality is one of the benefits of restrictive forest zoning.

Setting Water Quality Standards

Water quality standards are the foundation of DEQ's Water Quality Protection Program. Standards establish water quality goals by designating beneficial uses for each water body and setting criteria to protect those uses. These standards can be narrative and/or quantitative criteria and they serve as the basis for all Oregon's

pollution control programs related to water quality. The standards are used to set limits on the discharge of waste into Oregon's waters. Standards are also used to set requirements or establish Best Management Practices (BMPs) for nonpoint source control and land management programs, such as agricultural runoff, forest practices, and urban runoff. Failure to set and implement sufficiently protective standards can result in harm to fish and other aquatic life, human health, or recreational opportunities. DEQ has set water quality standards for approximately 140 pollutants. The Federal Clean Water Act requires DEQ to conduct a standard review at least once every three years to consider new Federal recommendations and to ensure that Oregon's standards are based on the latest science.

Beneficial Uses of Water

The term "beneficial use" provides a good example of how important it is to ensure that agencies and interested stakeholders are speaking the same language. Both the DEQ and WRD use the term "beneficial use" as defined in their statutes and rules. But, these terms are applied differently in a water quality context compared to a water quantity context. As a result, these Departments have to be very clear when talking to one another and to others. In this chapter, "beneficial use" reflects DEQ's terminology.

The Environmental Quality Commission (EQC) determines the beneficial uses for which each water body will be used, and then sets water quality standards for a variety of pollutants, in order to protect the most sensitive use. EPA must approve both the beneficial uses and water quality standards prior to their use in Oregon. Beneficial uses include:

- domestic water supply
- fishing
- industrial water supply
- boating
- irrigation
- water contact recreation
- livestock watering
- aesthetic quality
- fish and aquatic life
- hydropower
- wildlife and hunting
- commercial navigation and transportation

Matching the beneficial uses to water quality is a management strategy that the EQC and DEQ employ in recognition that not all beneficial uses require the same standard of water quality. Take for example a water body where swimming and fishing is expected. Here, DEQ would set bacteria standards to meet human health standards; it would set toxics limits for both human health and aquatic life; and it would set limits for dissolved oxygen, pH, temperature, and turbidity standards for aquatic life. For another water body, designated for other uses, water quality standards may differ substantially.

Surface Water

Every two years, DEQ assesses water quality and reports to EPA on the condition of Oregon's waters. **Figure 8** shows current surface water quality conditions in Oregon. DEQ prepares an integrated report that meets the requirements of the federal Clean Water Act (CWA). CWA Section 305(b) requires a report on the overall condition of Oregon's waters. CWA Section 303(d) requires identifying waters that do not meet water quality standards where a clean water plan, or Total Maximum Daily Load (TMDL), needs to be developed. The integrated report includes an assessment of each waterbody where data are available, and the list of waters identified under Section 303(d) as water quality limited needing a TMDL.

Once a waterbody is placed on the 303(d) list, the CWA requires states to develop a plan to meet clean water standards. This plan is called a TMDL, which describes the maximum amount of pollutants allowed from municipal, industrial, commercial, and surface runoff sources including natural background that can enter waterways without violating clean water standards.

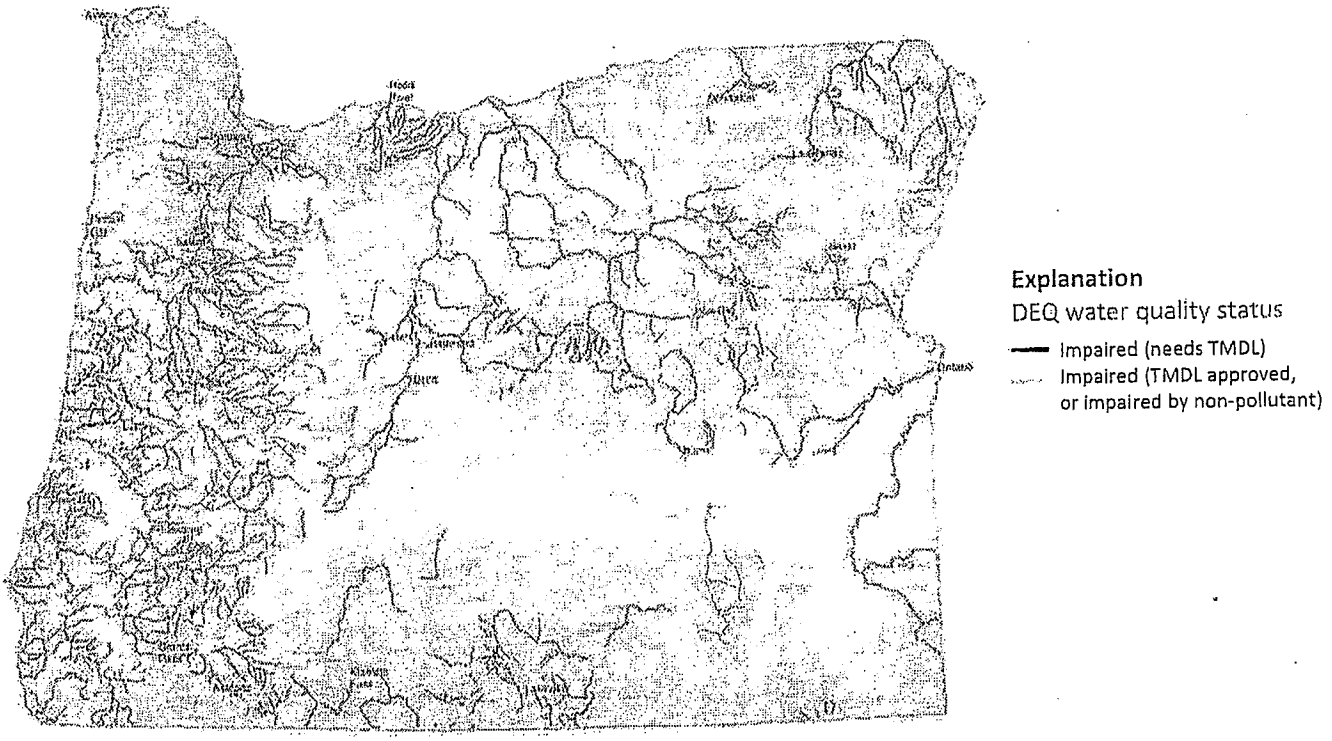

Figure 8: Oregon's 2004/2006 Water Quality Limited Waters

Implementing a TMDL often includes revising industrial and municipal wastewater permits to incorporate revised permit limits. On agricultural and rural residential lands, area plans are developed through the Oregon Department of Agriculture's (ODA) Agriculture Water Quality Management Act. On state and private forestlands, the Department of Forestry has the lead in providing water quality protection through the Forest Practices Act and long range management plans. In urban areas, local governments take the lead in developing TMDL implementation plans. The U.S. Forest Service and the Bureau of Land Management are responsible for developing water quality restoration plans for lands under their jurisdiction.

Under most circumstances, TMDL implementation plans for improved water quality rely on cooperation among landowners and land managers within a river basin. Local watershed councils, Soil and Water Conservation Districts, or other organizations serve as community-based coordination points for these united efforts. TMDL implementation plans describe actions that will be taken to reduce pollution.

Finally, DEQ monitors Oregon's waterways to determine the quality, presence and levels of pollution. DEQ monitors water quality with regular conventional pollutant sampling for more than 50 rivers and streams in Oregon. In addition, DEQ has a toxics monitoring program that regularly conducts special monitoring projects funded by grants from the Environmental Protection Agency and others. The data generated is used to set program priorities, develop TMDLs, the integrated report, permits as well as report on the conditions of Oregon's waters and work with others to reduce water pollution.

The most recent reports regarding Oregon's surface water quality concludes: [add summary here from DEQ's Integrated Report – expected in 2011]

Groundwater

Groundwater makes up approximately 95 percent of available freshwater resources in Oregon. Approximately 70 percent of all Oregon residents rely solely or in part on groundwater for drinking water. Over 90 percent of rural Oregonians rely on groundwater for drinking water.

Groundwater is present beneath almost every land surface and is sometimes at very shallow depths. It is

00003504

vulnerable to contamination from activities that take place on the land as well as from discharges of wastes and pollutants at or below the ground surface. Once groundwater becomes contaminated, it is very difficult to clean up. Groundwater contamination can persist for tens, hundreds, or even thousands of years. Likewise, groundwater that is being contaminated today may not affect beneficial uses until some time far into the future. This contamination could impair groundwater for use as drinking water and may affect the quality of the surface waters where it reaches the surface.

Nitrate Contamination

Serious health risks can result from contaminated groundwater. Nitrate is the most commonly detected contaminant, followed by pesticides, volatile organic compounds, and bacteria. The presence of nitrates in groundwater is a serious health concern, particularly for infants and pregnant or nursing women. Nitrate can interfere with the body's ability to carry oxygen to vital tissues, resulting in "blue baby syndrome." The U.S. EPA has set the maximum contaminant level to 10 mg/l for nitrate in public water supplies.

DEQ has primary responsibility for implementing groundwater protection in Oregon. DEQ uses a combination of programs to help prevent groundwater contamination from point and nonpoint sources of pollution, clean up pollution sources, and programs to monitor and assess groundwater and drinking water quality. DEQ implements some programs though partnerships with the Oregon Department of Human Services- Environmental Public Health (DHS), WRD, ODA, Oregon State University, and other state, local, and private organizations, businesses, and individuals. Investing in groundwater quality monitoring is a cost effective tool for addressing existing and potential future water quality problems.

In 2008, four percent of new wells inspected by Water Resources Department had construction issues, which if left unaddressed, could have caused public health or safety problems. It is more cost efficient to identify and correct problems at the outset, rather than clean up contaminated groundwater and soils afterward. Older wells also present a threat of contamination, as many were generally constructed to lower standards and may have deteriorated over time.

Source Water Protection

DHS and DEQ help to prevent groundwater and surface water contamination by providing Source Water Assessments to public water suppliers. Source Water Assessments identify the critical area around public water supplies: wells, springs and streams (i.e., drinking water source areas) where contaminated groundwater and surface water could have a negative impact on drinking water quality. Source water areas are shown in **Figure 9**.

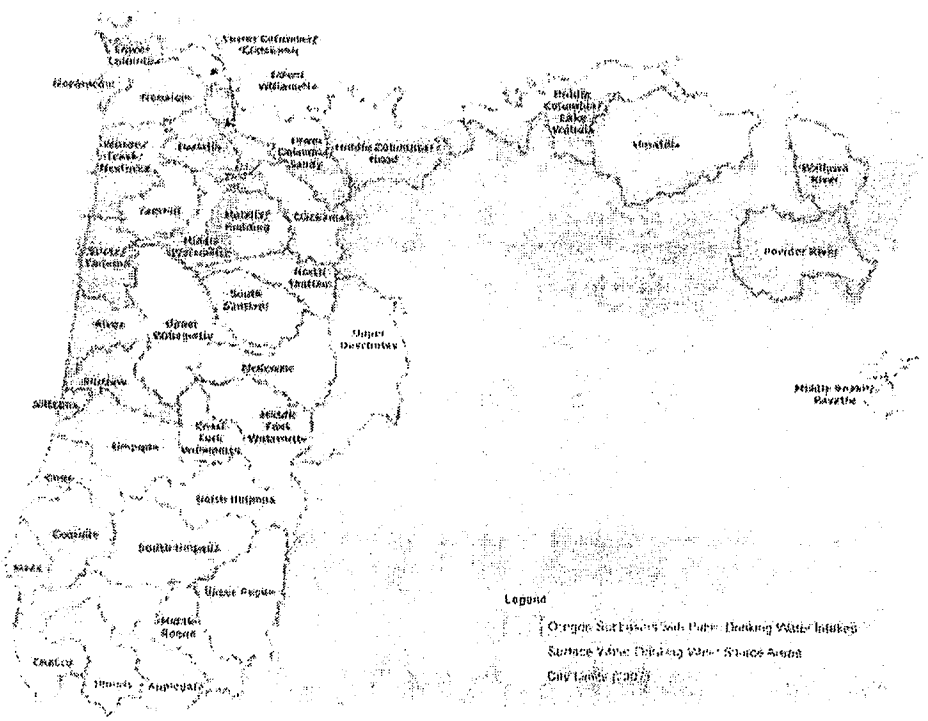

Figure 9: Oregon Subbasins with Drinking Water Intakes

Source Water Assessments also inventory potential human and natural contaminant sources within the drinking water source area and assess the water system's susceptibility to each contaminant source. Based on assessment results, DHS encourages public water systems to pursue best management

practices that reduce risks associated with the contaminant sources representing the greatest potential threat to drinking water quality. DEQ works with potentially human-caused sources of the pollutants to meet applicable standards for the protection of groundwater and surface water.

Issues Facing Water Quality

We know that water quality tends to degrade with lower streamflows. This is evident year after year during the summer months around Oregon when there is less water in rivers and the water temperature rises. What happens if we neglect the potential impacts regarding water quality in the process of planning? These are some of the issues we could face:

- Water quality is degraded to the detriment of water users, affecting Oregon's economy.
- "Water-quality limited" designations and TMDL issuance put in motion regulatory water quality improvement actions. This could mean more stringent pollutant discharge limits for point sources and changes in best management practices for non-point sources of pollution.
- Stricter federal regulations via the Clean Water Act and/or Safe Drinking Water Act.
- Further reductions in available "usable" water due to water quality degradation of sources.
- Costly arguments about how best to resolve the problem after the water quality has degraded. This can be very expensive and disruptive to communities and businesses.
- Increased drinking water treatment costs.
- Negative effects to aquatic species and habitat, including the iconic salmon.
- Increases in state issued human health and fish consumption advisories.

Many of our waters are already degraded to a level where they cannot provide for our most beneficial uses. State issued health advisories that recommend avoiding recreational swimming and reduce fish consumption to certain levels is just one indication that we are facing serious water quality issues today.

Temperature. One of the most widespread water quality issues throughout Oregon is temperature. Elevated temperature levels in rivers and streams can cause problems for fish and other aquatic life. There is a great deal of temperature data available for many parts of the state compared to data for other pollutants. Clean water plans (TMDLs) for temperature are an important tool for addressing salmonids that are listed on the federal Endangered Species List and other challenges faced by fish and other aquatic life that need certain water temperatures to survive. A common way to address temperature issues is through the retention and restoration of riparian areas. Riparian area protection and restoration programs and projects also improve habitat for listed salmonids and could address other pollution problems such as sedimentation and turbidity. In general, a lack of technical assistance statewide and high project costs often limit voluntary restoration efforts.

Toxic Pollutants. Another widespread pollution issue that DEQ is working on is related to toxic pollutants. Many toxic pollutants are ubiquitous and diffuse in the environment and are not released as "point" source pollutants, which poses a significant challenge for DEQ in managing their presence in Oregon's environment. To

Restoration Cools Creek 10 Degrees
An Oregon Plan Success

Long-term temperature monitoring at a restoration site on Willanch Creek, Coos County, has shown that the maximum seven-day temperature at the downstream end of the restoration site dropped from 74° F to 64° F in just eight years, 1997 - 2005. Water temperatures of 64° F or lower are essential for the growth and survival of juvenile Coho salmon. Willanch Creek is a Coos Bay tributary that was plagued by eroding banks, old culverts that limited fish access to upstream areas, and high water temperatures caused by a lack of streamside trees and shrubs. From 1991 to 2004, project partners worked hard to remove invasive plants, stabilize slumping banks with natural materials, replace inadequate culverts with bridges, place large pieces of wood in the creek, install livestock fencing, and plant native vegetation.

~ From the Oregon Plan for Salmon and Watersheds, Coho Restoration Stories
http://www.oregon.gov/OPSW/stories/stories.shtml

address this, DEQ is developing a toxics reduction strategy, with the goal of using a comprehensive approach to reduce toxic pollutants in Oregon's environment. Where possible, the strategy will identify reduction options that address a range of toxic pollutants that move between air, land and water, thereby increasing the efficiency of reduction efforts while ensuring Oregon addresses the problem comprehensively. DEQ will also place a major emphasis on reducing toxic pollutants at the source, rather than managing them after they are released.

Oregon has already made some very significant accomplishments to restore water quality through various public and private partnerships. According to the Oregon Plan Biennial Report, in 2006 and 2007 alone, funding for reported restoration projects totaled $123.8 million. Sixty-seven percent of those funds were provided by federal and state government sources. These funds help support soil and water conservation districts and watershed councils that work directly with private landowners to implement voluntary projects for water quality monitoring, river clean-ups, and various stream habitat improvements such as invasive species removal, plantings, grazing management, and nutrient management.

Next Steps

Opportunities remain to improve water quality through an integrated strategy. The list below summarizes some of the challenging water quality issues that could be addressed in the strategy. This list, while not complete, serves as a discussion point for future work. Identifying the problems that contribute to poor water quality will help us determine what solutions to pursue as we move forward.

- Emerging contaminants.
- Lack of coordination and consistency with state land use planning goals/procedures.
- Water and wastewater infrastructure is old, deteriorating, and in desperate need of repair.
- How to maintain forestland in forest uses and promote the establishment of new forests to support high quality water.
- The cumulative effects of wastewater discharges.
- Total Maximum Daily Load requirements do not fully integrate water quantity and water quality.
- Stormwater management is a challenge that faces many communities and businesses.
- The synergistic effects of multiple contaminants on human and aquatic life are poorly understood.
- Research and analysis of the impacts of water quality degradation on aquatic life.
- Lack of resources to conduct a statewide groundwater assessment and monitoring program.

Integrating Water Quality Needs

Various techniques, such as point source pollution management, non-point source pollution management, and restoration efforts can protect and restore water quality over time. Keeping pollutants out of the water to begin with is certainly the easiest way to protect water quality and help keep water treatment costs down. Often times, unused or expired medications are disposed of by flushing down the drain in homes, care facilities, medical clinics, doctors' offices, and hospitals. Wastewater treatment plants and septic systems usually do not treat pharmaceuticals, which mean these pollutants are present to some degree in our surface water and groundwater supplies. Yet, the proper collection and disposal of pharmaceuticals can be costly and time consuming and poses funding and logistical hurdles that have stymied most communities. Currently, local pharmaceutical collection events are held around the state, although these events are rare.

In addition, there have been a number of legacy pesticide collection events around Oregon to provide an opportunity for farmers and others to bring old pesticides that are no longer used to a central location to properly dispose of them free or at a reduced charge. These collection events help to remove old unused or unusable pesticides that pose a direct threat to Oregon's water quality. Many of these pesticides are stored in deteriorating containers, and if spills, leaks, or other releases of these pesticide wastes occur, there could be significant impacts to surface water and groundwater.

Integrating water quality and water quantity planning efforts could alter how we characterize water that was previously viewed as a "liability" to communities. Recycled water, such as treated effluent, graywater, and stormwater, could be used to supply certain beneficial uses before discharge if the quality of the water is high enough for continued use. Already, conversations regarding recycled water use have started to develop in Oregon. It is important to consider that recycled water and conservation practices, with their more efficient means of distribution and use, could have unintended effects that result in lower return flow to streams, or public health implications. If Oregonians pursue ways to recycle water, it is important to identify the barriers to safe, effective use of recycled water. These may be real, perceived, public reactions to the reuse of treated effluent from wastewater treatment plants.

Conclusion

As society changes, water quality needs and standards will change as well. These standards will have direct impacts on water bodies, beneficial uses, cost, communities, and businesses. Water management decisions must always be made while considering the impacts and needs of both water quantity and water quality. Although many natural resources state agencies, other state agencies, local, and federal agencies already coordinate closely regarding "on-the-ground" projects, there are institutional, legal, and policy barriers in place that prevent us from managing water resources better.

Sources

Oregon Water Management Program. The Program establishes statewide policies and principles related to a wide range of water-related topics including storage and water allocation. These policy and principle documents can be found in Administrative Rule OAR 690-400-000 through OAR 690-410-080.

For more information about DEQ's Beneficial Uses and water quality standards, visit: http://www.deq.state.or.us/wq/standards/uses.htm.

Institute for Natural Resources. 2009a. Management of streams systems in an ecosystem dynamics framework. Recommendations from the February 17, 2009 seminar. http://egov.oregon.gov/ODF/RESOURCE_PLANNING/docs/INR_Aquatics_White_Paper.pdf

Oregon Department of Environmental Quality, Groundwater Protection Program. http://www.deq.state.or.us/wq/groundwater/groundwater.htm

Oregon Department of Environmental Quality, Household Hazardous Waste Program: Pharmaceuticals. http://www.deq.state.or.us/lq/sw/hhw/pharmaceuticals.htm

Oregon Department of Human Services. Technical Bulletin: Health Effects Information for Nitrate. June 2001.

Oregon Department of Environmental Quality. Groundwater Quality Protection in Oregon. A Report to the Legislature. January 2009.

Oregon Watershed Enhancement Board. *Oregon Plan Biennial Report 2007 – 2009.* Salem, Oregon.

Source water Protection Program in Oregon. For more information, visit the following websites:
Department of Human Services, http://www.oregon.gov/DHS/ph/dwp/gw_swp.shtml#swp
Department of Environmental Quality, http://www.deq.state.or.us/wq/dwp/dwp.htm

Ecology and Ecosystems

The purpose of this paper is to highlight the ecological and ecosystem water-related issues that Oregon may face as it grapples with integrated water resource management in the future. Integrated water resource management addresses not just how much and what quality water is within a stream, but also considers the health and management of habitat.

Human activities such as land-use practices, competing demands for water resources, and pollution can have a significant and detrimental effect on Oregon's ecosystems. Natural processes, such as droughts, floods, and fires affect ecosystem health both positively and negatively. Inadequate legal protections and lack of coordination among state, federal, and local organizations can jeopardize past and future efforts to protect and restore the environment. This paper is not intended to cover all of the issues affecting ecosystems in Oregon, but will focus on some of the significant challenges we can already anticipate, as well as some of the restoration projects that have benefited local communities.

Ecosystem Services

Oregon's ecosystems provide a wide variety of benefits and services to our communities. The term "ecosystem services" is defined as "benefits that humans enjoy as a result of natural processes and biological diversity," (Senate Bill 513, 2009). These services sustain economically viable activities such as farming, ranching, fisheries, timber harvesting, electrical generation, and outdoor recreation, while providing water quality control, carbon sequestration, flood control, fish and wildlife habitat, and productive soils. By further degrading or neglecting functioning ecosystems, we might decrease our own quality of life as well as the fish and wildlife that depend on these systems. This degradation subsequently results in a need to "engineer" solutions and to mimic ecological functions at great expense. For instance, it costs far more to obtain drinking water when provided by a multi-million dollar treatment facility than a relatively healthy natural source; flooding is far more frequent and costly when waters cannot be well absorbed by the physical environment; crop production costs are higher when soil productivity is compromised; and fish populations are more expensive to maintain through restoration actions and hatchery operations than through the maintenance of natural habitat.

Defining Ecology and Ecosystems

Generally, the term "ecosystem" refers to a system of interdependent relationships between organisms and their surrounding environments.

"Ecology" is the scientific study of the interactions among these organisms and their environments.

Groundwater. Ecosystems that are dependent on groundwater are areas that require access to groundwater to maintain their ecological structure and function. Groundwater dependent ecosystems comprise a diverse, complex and often biodiverse subset of the world's ecosystems and can be located in marine, coastal, riparian, in-stream, terrestrial and in cave and aquifer environments. Examples include springs, many wetlands, and base flow to streams and rivers in late summer months. Groundwater ecosystems support a disproportionately large number of plants and animals relative to the area they occupy and offer multiple ecosystem services, or benefits, to humans, such as clean water and recreational opportunities. Many of the cold-water salmonids thrive in Oregon because of the high quality and quantity of water supplied by the springs and groundwater supported wetlands, due to a large extent to the unique geology of Oregon.

Some of the most significant ecosystem services provided by groundwater systems include water supply for human use, as well as cold clean water, and summer low flows for aquatic and riparian dependent species. Other benefits to recreation include river rafting during summer months, wildlife and bird watching. Aesthetic and photographic opportunities associated with water features such as waterfalls and springs, and cultural and spiritual values.

Groundwater - Surface Water Relationship. Surface water interacts with groundwater in three basic ways: streams gain water from inflow of groundwater, via springs or seepage, through the streambed (gaining streams), they lose water to groundwater by outflow through the streambed (losing streams), or they do both, gaining in some reaches and losing in others. Gaining streams represent locations where cooler groundwater emerges and contributes to a stable base flow, helps sustain flows during the summer months, and provides prime spawning conditions. Losing streams provide a potential route of contamination to groundwater quality, as run-off enters streams that eventually percolate back into the ground.

Wells that are hydraulically connected to surface water can deplete streamflows at varying levels and over extended periods, long after pumping ceases. Managing surface water and groundwater conjunctively is a challenge. A lack of data that describes the connection between groundwater and surface water results in an incomplete understanding of available water, groundwater recharge, gaining vs. losing reaches, return flows, sources of contamination, and ability to provide sustainable water supplies over time.

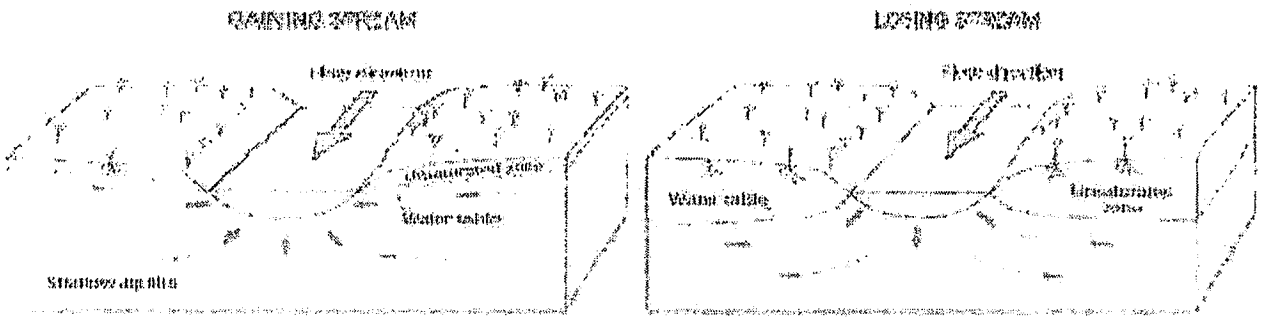

Figure 10: Groundwater Interaction with Surface Water

Surface Water. Surface water sources in Oregon are also complex, contributing to very different ecosystems. Peak and ecological flows are a subset of stream flows that are directly tied to the ecology of the stream system. These flows serve several functions, such as to help maintain the physical attributes of a stream (often flood or peak flows), act as behavioral triggers for certain life stages of aquatic species (migration or spawning), and to overcome threats to aquatic life (harmful pollutants or stream heating). Surface water, like groundwater, supports the majority of out-of-stream uses throughout the state, such as irrigation, municipal use, and industrial use. Surface water also provides for instream needs for recreation, aesthetic values, pollution abatement, and aquatic life.

Natural Storage Systems

Riparian Areas. A riparian area is the zone of transition from an aquatic ecosystem to a terrestrial ecosystem. These areas are located adjacent to lakes, reservoirs, estuaries, wet meadows, and streams. According to the 2000 State of the Environment Report, riparian areas represent a conservative estimate of 15 percent of the total area in the state. Riparian areas help to improve water quality, reduce flooding impacts, moderate streamflow, and provide habitat for fish and wildlife. The plants that grow in riparian areas are essential to preventing erosion, filtering pollutants and sediment, and providing shade to keep streams cool. A healthy riparian area will include a variety of types and ages of plants, including trees, shrubs, grasses and groundcover. A few of the common plants found in Pacific Northwest riparian areas include alder, cottonwood, elderberry, snowberry, willow, and western hemlock. Many human activities take place in riparian areas, in both rural and urban landscapes, such as timber harvesting, reforestation, road construction, herbicide and pesticide use, grazing, mining, agriculture, and residential development. If poorly planned or implemented, these activities can have detrimental effects on the function of these areas.

Wetlands and Floodplains. Through their ability to hold and slowly release water, filter and biologically process nutrients, and provide shade and habitat, Oregon's upland wet meadows, riparian wetlands, and flood

plain habitats have a direct impact on water storage, flow, water quality, habitat quality and water temperature. This can also be said of the relationship between floodplain habitat health and a stream's resilience to damage caused by floods. The habitat structures and functions of wetlands, wet meadow storage, floodplain absorption, vegetated shade, filtration, and peak flows directly influences the quality and quantity of water, and vice versa. Habitat drives water quality and quantity, not simply something affected by them. Oregon has lost an estimated 38 percent of its original wetlands. In the Willamette Valley, approximately 57 percent of wetlands have been lost. A recent study shows that the Willamette Valley continues to lose more than 500 acres per year. The Klamath Basin has lost an estimated 75 percent of original wetlands, primarily due to government-sponsored conversion to agricultural production (Morlan, 2000).

Forest Lands. Oregon is comprised of 61 million acres of land. Nearly 50 percent of the state, or 30 million acres, is classified as forestland. Oregon's forests help filter drinking water, keep water cool, provide habitat for diverse animal and plant species, supply oxygen, moderate temperatures and rainfall, and store atmospheric carbon. Healthy forests promote soils that provide natural filtration to keep streams clean and water quality high. Most of Oregon's municipal water systems use water that originates from forestlands, including those managed for wood production.

The quality of this source water is among the best in the nation. At the state scale, data collected between 1998 and 2007 indicate more than 90 percent of the sampled sites on forestlands showed an Oregon Water Quality Index in good or excellent condition, and the remaining sites in fair or lower condition. Water quality was highest in the Willamette, Middle Columbia, and Lower Columbia hydrologic units. Overall water quality in the North Coast was intermediate compared to the other units. The South Coast showed the lowest overall water quality.

Water quality is typically considered a major issue in several state hydrologic units, such as the Willamette. However, forest sites generally show a lower percent of stream miles in poor or most disturbed conditions compared to agricultural and urban land uses. A 2009 report prepared by the Department of Environmental Quality shows water quality highest for generally higher elevation, higher stream gradient federal sites, with 97 percent in good or better conditions. State sites showed 89 percent in good or better conditions. Private industrial sites had 87 percent in good or better conditions. Private non-industrial sites, which are more likely to be intermixed with other land uses, had 77 percent in good or better conditions, and should perhaps be the highest priority for closer future study. Promoting the maintenance of forestland in forest uses and the establishment of new forests are needed as key elements to ensure high quality water and protection of soil productivity.

Watersheds

A watershed is the entire land area drained by a stream or system of connected streams where all of the originating streamflow drains through a single outlet.

Sample functions and characteristics of a healthy watershed include streamflow regulation, groundwater recharge, rainfall capture and storage, and minimal erosion. A healthy watershed is able to resist or quickly recover from disturbance events, such as floods, fires, and insect outbreaks. The health of our watersheds contributes to quality soil, water, and an environment that is able to support both native aquatic and riparian species.

Enhancing Oregon's waters through the management of riparian and upland areas is a goal identified by the Oregon Legislature. Numerous Watershed Councils throughout Oregon are working to achieve this goal by improving watershed health through protection, restoration, and enhancement.

Forests are part of the essence of Oregon, and our waters benefit from their sound management. However, Oregon's forest values are also at risk:

- The density of homes in private forests has doubled in the last decade.
- Forests are being fragmented, converted to other uses, and encroached upon by development.
- Rising expenses of owning forestland, and the land's growing value as real estate, creates increasing pressure to sell private forestland for development.

- Invasive species, climate change, more damaging fires, and the neglected condition of some federal lands threaten public and private forests.
- Federal forestlands, particularly in drier regions, have massive ecological restoration needs, and resource-dependent rural communities are distressed.
- Oregon's growing, urbanizing population has diverse and changing forest values.

There are solutions. The many environmental, economic, and social values of forests are interdependent and provide a basis for consensus. Diverse forests and a range of benefits result when landowners are able to emphasize multiple values – wood production, nature emphasis, or mixed uses. Awareness is growing that keeping forests in productive forest use should be a primary goal. Keeping forests as forests requires:

- Public support and investment in forestry and resource protection;
- Policies that make continued forest ownership an economically viable alternative to conversion;
- A statewide vision for sound, sustainable forest management, as provided in the Board of Forestry's *Forestry Program for Oregon.*

Estuaries. An estuary is a highly productive environment located at the lower end of a river where the current meets the sea tide. Estuaries provide important habitat for many fish and wildlife species for rearing, nesting, foraging, and as a migration route. Numerous species can be found in Oregon's estuaries, such as salmon, herring, flounder, crabs, oysters, clams, birds, ducks, geese, shorebirds, and harbor seals. There are 22 major estuaries in Oregon; the Columbia River estuary at Astoria is the largest in area at approximately 80,811 acres, although most estuaries along the coast are relatively small. There are several estuary types; some are dominated by rivers with small tideland areas. Most estuaries typically experience high winter floods that deposit large volumes of sediment, coupled with low summer streamflow and high seawater content. Others, such Sand Lake and Netarts Bay estuaries are "bar-built" and receive very little freshwater. Low summer flows from rivers can cause the mouth of an estuary to be completely closed off; they are known as "blind" estuaries. The variety of estuary types also means that habitats vary and include marshes, eelgrass beds, mudflats and tidal channels. Some of the issues affecting the health of Oregon's estuaries include increased sedimentation and nutrient load, introduced nuisance species, development, recreational pressures, and low freshwater inflows.

The Diversity of Oregon's Ecosystems

Oregonians have always been proud of the place they live; proud of the diversity of landscapes and people; and proud of Oregon's strong ties to its natural resources, natural beauty and fish and wildlife. When Oregonians describe the state, we often note the diverse landscapes that range from coast to desert, from mountain to valleys, to rainforest. Areas of Oregon are grouped by similar vegetation and climate and are referred to as "ecoregions." Oregon's 2006 Conservation Strategy, produced by the Oregon Department of Fish and Wildlife, describes 8 ecoregions across Oregon's 98,386 square miles. The Conservation Strategy provides an overview of the land uses, economies, ecology, species and habitat, conservation issues and approaches, invasive species, and various conservation projects for each ecoregion. The diversity of Oregon's landscape that we admire so much presents a challenge for developing statewide water resource solutions.

Status of Oregon's Native Fish Species

The health of an "indicator species," like the proverbial "canary in the coal mine" can be an indicator of overall ecosystem health, and can offer early signs of stress, such as disease or pollution. Oregon's streams and lakes provide substantial habitat and are essential for fish and wildlife to live, reproduce, and thrive. Out of numerous species that depend on Oregon's water resources, the most visible indicator species are native salmonids (salmon, steelhead, and trout) who depend on cold clean water. Using these species as indicators of overall aquatic ecosystem health paints a dire picture: Since 1991, NOAA Fisheries' Office of Protected Resources has listed 27 Pacific salmonid species under the Endangered Species Act (ESA), and have delisted

zero species. Many populations of Chinook salmon, Coho, Chum, and Steelhead are at a fraction of their historic levels and are listed as threatened or endangered. In 2005, the Oregon Department of Fish and Wildlife published a Native Fish Status Report, noting that of 69 "Species Management Units," a population count of Oregon native fish species, 35 SMUs were "at risk," and 9 were already extinct. See **Figure 11.**

Figure 11. Species Management Units for Oregon Native Fish Species

Species	Species Management Units	Not at Risk	Potentially at Risk	At Risk	Extinct	Not Assessed
Salmon						
Coho	5	2	0	1	2	0
Fall Chinook	5	2	2	1	0	0
Spring Chinook	8	0	2	4	2	0
Chum	2	0	0	1	1	0
Sockeye	2	0	0	0	2	0
Steelhead						
Winter Steelhead	4	1	2	1	0	0
Summer Steelhead	7	2	1	3	1	0
Trout						
Redband	7	0	2	5	0	0
Cutthroat	8	3	1	3	1	0
Bull	12	1	1	10	0	0
Other						
Borax Lake Chub	1	0	0	1	0	0
Hutton Springs Tui Chub	1	0	0	1	0	0
Oregon Chub	1	0	0	1	0	0
Foskett Springs Speckled Dace	1	0	0	1	0	0
Pacific Lamprey	1	0	0	1	0	0
Western Brook Lamprey	1	0	0	1	0	0
Green Sturgeon	1	0	0	0	0	2
Oregon White Sturgeon	1	0	0	0	0	1
TOTALS	69	11	11	35	9	3

Limiting Factors / Barriers

The importance of fish to Oregon's ecology and economy cannot be overstated. Native fish such as salmon are an Oregon icon and support a vigorous recreational and industrial economy. Factors that limit the productivity and overall health of fish species are many, some of which include degraded spawning and rearing habitat, poor water quality, dewatered streams, poor riparian conditions, land use practices, climate change, passage barriers, species competition, competing uses for water, overharvesting, and poor ocean conditions.

Stream Conditions. There are certain stream conditions that are necessary to support the life cycle of fish. Stream conditions that are necessary also vary with the species needs. Coho, for example, need gravels that are clean with various sizes to create nests and deposit their eggs and they prefer to spawn and rear in small, relatively flat streams. Cool water is a requirement for rearing, as well. Wetlands, off-channel ponds, and other slackwater areas provide small fish (fry) with safe areas to reside in during the winter season when the current is swift. The complexity of the habitat, which includes both large and small woody debris, directly contributes to the health and function of salmon bearing streams.

Climate Change. Climate change will continue to affect Oregon's ecosystems, as indicated by increasingly sophisticated scientific models. Management of aquatic ecosystems in response to climate change will need to mirror the management designed to perpetuate dynamic processes, including efforts to maintain stream flows, minimize floodplain and riparian diversions, and restore interactions between rivers and uplands.

Land Use. All across Oregon, urbanization, agriculture, and certain forest practices have placed pressures on the overall health of aquatic ecosystems. The Willamette ecoregion, for example, has lost important river features, such as off-channel aquatic habitat, gravel bars, and deep channel pools from changes to land use. Runoff of sediment from poorly designed logging, grazing, roads, urban and agricultural activities enters waterways, which can have detrimental effects on species reproduction and survival.

Water Use. Competing uses of water has resulted in lower flows in river and streams, and in some cases, flows may not even exist in late summer months. Low flows often mean higher water temperatures and increased nutrient concentrations. Historically accessible habitat for many aquatic species has been greatly reduced or eliminated by dams and improperly sized or misaligned culverts, and changes in the hydrologic regime.

Diversions that lack proper fish screening or by-pass devices can increase fish mortality and injury as fish enter diversion ditches, machinery, or irrigated fields. Today, fish screens or bypass devices are often required as condition of a water right permit or transfer. The Oregon Department of Fish and Wildlife operates the state's fish screening program and has helped install over 1,300 fish screens through their cost-share program since its inception in 1991. Maintaining and inspecting fish screens to ensure they are properly working is challenging considering their high exposure to debris, sediment, and changes in temperature that can all cause screen damage and potentially lead to fish loss at the diversion.

Invasive Species. According to the Oregon Invasive Species Council, an invasive species in a non-native species that can cause economic or environmental harm to human health. It can be a plant, animal or any other biological viable species that enters an ecosystem beyond its native range. Invasive species disrupt the natural function of an ecosystem by competing and replacing native species and disrupting the natural habitat. Oregon's rivers, lakes, and streams are greatly affected by their presence. Invasive species can interfere with water use by reducing flow in irrigation canals and drainage ditches, which can result in flooding and damage to canal banks, structures and pumps. Municipal use and power development are also impacted by invasive species, which can cause problems in water intake pipes, filtration equipment, and generation plants. Certain species of cyanobacteria, commonly referred to as blue-green algae, can be both invasive and toxic. It can form thick foam or scum on the water's surface and produces toxins or poisons that can cause serious illness or death in pets, livestock, wildlife and humans. In short, the presence of invasive species is wide ranging, affecting our forests, farms, and our waters, which in turn impacts our economy, ecosystem and human health, and overall quality of life.

Water Quality. Currently, there are almost 15,000 river miles that do not meet Oregon's water quality standards for one or more pollutant. A variety of human impacts, both urban and rural, contribute to the degradation of water quality. Pressures on species and ecosystems will likely increase with the growth of Oregon's population and climate change impacts—with riparian habitat and upland health directly driving the water quality issues of temperature, nutrient removal, and fine sediment filtration. Water quality degradation can put significant pressures on fish, wildlife and ecological systems. Water quality can degrade from habitat loss, various pollutants, and introduced aquatic species. For example, toxics that enter wetlands or waterways poses risks to both fish and wildlife. Some toxics can be lethal to species, whereas others can result in reduced fish egg production, nest and brood abandonment, lower disease resistance, weight loss and other problems that can reduce adult survival and lower population abundance. Another factor affecting the growth and survival of aquatic organisms is stream temperature. Elevated stream temperatures increase the risk of disease-related mortality and also results in increased competition for food. Addressing issues affected by

both water quality and water quantity, including temperature, dissolved oxygen, and sediment transport is a challenge, but will likely be an important piece of the strategy.

Adequate Protections for Instream Needs. Protecting streamflow and lake levels, which are needed to support public uses, is a high priority for the state. There are many rivers, lakes and streams that can provide significant public benefits and protecting these waterways is a long-term goal. While many streams in Oregon are legally protected an instream water right, there are many streams that are not protected. For those streams that are protected by a water right, it is difficult to enforce regulation to protect these rights with limited field staff. The Oregon Department of Fish and Wildlife has plans to apply for new instream water rights where data shows additional need and to generate data on streams where information or data is missing. However, ongoing resource constraints have prevented these plans from moving forward.

There is much about instream needs that we do not yet know. For instance, there is not much information about flow needs, for species other than the high profile salmonid species (e.g., lamprey, chub, white fish, other native fish species, amphibians, macroinvertebrates, etc.). Base flows generally refer to the water required to sustain basic life functions of aquatic species. In Oregon, we have only determined base flow needs for some streams and only for salmonid species. In addition, there are flows required to ensure channel maintenance (the physical characteristics of the stream) and to trigger biological processes (such as spawning and other life stages). Not much information exists at all about these flow needs.

Finally, there are flows needed to maintain water quality throughout a stream system. The state's Department of Environmental Quality has begun work in this area, with "TMDL Modeling" but, again, not much information exists today.

Institutional Coordination. Responsibility for managing, protecting, and restoring Oregon's ecosystems falls across a broad range of local, state, and federal agencies, as well as on private landowners and local organizations. Oregon, perhaps just as much or more than any other state, has a rich history of work in this area, using tools and institutions to help address and improve ecological conditions. Fully accounting for and building upon the myriad programs that already exist will be a challenge, much less creating integrated plans and data sets.

Promoting Incentives. It is becoming increasingly evident that regulations alone will not suffice to mitigate our collective impacts on air, water, and the ecosystem. Regulations and permits have taken us a long way toward meeting goals for specific ecosystem values in Oregon. Despite these advances, however, the collective actions of individuals continue to take their toll on climate, water quality, habitat, and streamflow. A better and broader set of incentives could encourage or allow more Oregonians to restore stream health. There are many tools available to choose from, including creating and regulating markets for ecosystem services, and using the full potential of state and federal programs, such as the Allocation of Conserved Water Program, Conservation Reserve Enhancement Program, Wetlands and Healthy Forest Reserve Programs,

Working for Ecosystems

Many local, state and federal entities are actively working to protect and restore ecosystems in Oregon through programs, partnerships, grants, and on-the-ground projects. They include:

Oregon Department of Fish and Wildlife
Oregon Department of Forestry
Oregon Department of Agriculture
Oregon Watershed Enhancement Board
Oregon Water Resources Department
Oregon Parks and Recreation Department
Oregon Department of State Lands
Oregon Department of Environmental Quality
Watershed Councils
Soil and Water Conservation Districts
Irrigation Districts and other Water Users
The Freshwater Trust
WaterWatch of Oregon
Deschutes River Conservancy
Klamath Basin Rangeland Trust
The Nature Conservancy
Bonneville Power Administration
Columbia Basin Water Transaction Program
Northwest Power and Conservation Council
National Fish and Wildlife Foundation
National Oceanic & Atmospheric Association
National Marine Fisheries Service
Natural Resources Conservation Service

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etc. Increasing efforts to inform landowners of this various incentives programs could potentially bring significant benefits to ecosystems on privately owned lands in Oregon.

Ecological Protection and Restoration

Although there are many threats facing our ecosystems, Oregon has heavily invested in ecological protection and restoration already, with many successes. Land management is not always a detriment to Oregon's ecosystems, but it can have positive effects, as demonstrated by the voluntary restoration accomplishments documented under the Oregon Plan for Salmon and Watersheds. Below are some examples of streamflow restoration and salmon protection tools and efforts. These examples demonstrate the resiliency of Oregon's ecosystems so long as restoration efforts begin sooner rather than later.

Regulatory Tools

The **Scenic Waterway Act**, established in 1970, recognized that many or Oregon's waters possess outstanding scenic, fish, wildlife, recreation, historic and outdoor recreation values. The Act was passed to maintain the free-flowing character of designated rivers and lakes in quantities necessary to support recreation, fish and wildlife uses. It specifically prohibits the construction of dams or other impoundments. Land use activities that can impact a scenic waterway or adjacent land, such as road or building construction, mining, forest harvesting, are limited or regulated by several state agencies. Oregon Parks and Recreation Department plays a large role in the management of the Scenic Waterway Program. The Oregon Department of State Lands, Department of Environmental Quality, Department of Fish and Wildlife, and the Water Resources Department also share responsibilities for protecting scenic waterways through various permitting and regulatory programs, as do local governments through their comprehensive planning and land use permitting responsibilities.

Oregon's Scenic Waterway Act has led to one of the most extensive scenic waterway systems in the country, with more than 1,100 river miles protected for the beneficial uses of recreation, fish and wildlife. The designation of scenic waterways is a well-established tool that brings benefits to a local economy through tourism and recreation while at the same time protecting water quality and quantity and other ecological values.

Since the adoption of Oregon's 1987 **Instream Water Right Act**, the Water Resources Department has converted more than 500 of the state's minimum perennial stream flows to instream water rights and has issued more than 900 state agency-applied rights to protect water instream for fish use, pollution abatement and recreational purposes. Applications to protect water instream are filed on behalf of the Department of Environmental Quality, Department of Fish and Wildlife, and Parks and Recreation Department and held in trust for public benefit by the Water Resources Department.

Not only can state agencies apply for water rights to protect water instream, water users with existing water rights can transfer water instream using several tools and programs administered by the Water Resources Department. Water users can transfer their out-of-stream use, such as irrigation for agricultural crops, to instream use, on a temporary or permanent basis. The water user can transfer their entire water right instream, or a portion thereof. To date, 61 permanent instream transfers have been approved, representing more than 285 cfs. More than 70 percent of water put instream on a permanent basis in Oregon is senior water, with some certificates pre-dating Oregon's 1909 water code.

Another program that can enhance instream flows is the **Allocation of Conserved Water Program**. This voluntary program has existed for well over 20 years to provide incentives that promote conservation and maximize the beneficial use of water. Common conservation practices include lining canals, moving points of diversion downstream, and changing the water distribution system from flood irrigation to sprinkler or drip irrigation. Under this program, a water right holder who conserves water may use a portion of the conserved

water on additional lands, while a portion of the conserved water is permanently protected instream. To date, more than 44 applications have been approved, resulting in almost 95 cfs permanently protected instream.

Through these programs and partnerships, Oregon has become a national leader in flow restoration, with more than 300 current instream leases, instream transfers, and allocations of conserved water that restore about 1,700 cubic feet per second (cfs) of streamflow for fish, wildlife, recreation, and pollution abatement. This is more than triple the amount for the states of Washington, Idaho, and Montana combined. During 2009, 43 percent of instream leases came directly from customer transactions with the Water Resources Department. The instream program benefits greatly from active partnerships with The Freshwater Trust, Deschutes River Conservancy, and the Klamath Basin Rangeland Trust.

The Oregon Forest Practices Act became law in 1971 and was the first state forest practices act in the nation to regulate commercial forest operations on non-federal forestlands. Both the statutes and the administrative rules for the Act have evolved over time and today provide a comprehensive set of regulations designed to encourage the sound management of soil, air, water, fish, and wildlife resources. Some of the topics addressed by the Oregon forest practice rules include reforestation, forest chemicals, road construction and maintenance, harvesting, sensitive resource site protection, and water quality protection. The purpose of the water protection rules is to protect, maintain and, where appropriate, improve the functions and values of streams, lakes, wetlands, and riparian management areas. Active management is encouraged where appropriate to meet this purpose. These functions and values include water quality, hydrologic functions, the growing and harvesting of trees, and fish and wildlife resources. Voluntary compliance by private forest landowners with the Forest Practices Act remains very high and water quality on forestlands is the highest of all Oregon land uses.

Statewide Initiatives and Partnerships

The Oregon Plan for Salmon and Watersheds (Oregon Plan) is a statewide initiative launched in 1997 to help restore healthy watersheds that support the economy and quality of life of Oregon. Agriculture, forestry, recreation, fisheries, and industry all need healthy watersheds, along with every person and community in Oregon. The Plan has a strong focus on salmon, largely because of the significant cultural, economic, and recreational importance to Oregonians - and because they are important indicators of watershed health. The Plan organizes specific actions - called "measures" - around the factors that contribute to the decline in fish populations and watershed health. Most of these measures focus on actions to improve water quality and quantity and restore habitat. Landowners and other private citizens, community organizations, interest groups, and all levels of government come together to organize, fund, and implement these measures. Oregon's watershed councils and soil and water conservation districts (SWCD's) assist landowners with projects and lead restoration efforts in many watersheds. Many projects, including financial support for watershed councils and SWCD's, are funded primarily by lottery dollars administered by the Oregon Watershed Enhancement Board. Maintaining continued political and funding support for the Oregon Plan for Salmon and Watersheds is a challenge.

The voluntary actions and willingness of private citizens to implement restoration projects on their own property has been and will continue to be fundamental to the success of the Oregon Plan for Salmon and Watersheds. For 2006 and 2007, nearly 1,300 restoration projects were completed on private land. During that same period, landowners enrolled over 11,000 acres in state and federal partnership programs to improve riparian conditions for fish habitat and water quality.

The Oregon Plan has also bolstered inter-agency and state-federal coordination and collaboration. In 2002, for example, the Oregon Water Resources Department and the Oregon Department of Fish and Wildlife completed a joint project that identifies priority areas for streamflow restoration in basins throughout the

state. These priority areas represent watersheds in which there is a combination of need and opportunity for flow restoration to support fish recovery efforts under the Oregon Plan for Salmon and Watersheds.

Regional and Local Efforts

The Umatilla Basin Project, authorized by Congress in 1988, is one example of a successful effort to reintroduce salmon after 70 years of absence from the Umatilla River. This effort, involving the Confederated Tribes of the Umatilla Indian Reservations, local irrigators, the U.S. Bureau of Reclamation, Bonneville Power Administration, Oregon Water Resources Department, and Oregon Department of Fish and Wildlife, relied on a number of policies and practices, including: use of Columbia River water instead of Umatilla River water for irrigation, fish passage improvements, stream habitat enhancement, and a fish hatchery. Today, enough adult spring Chinook have returned to the Umatilla River to provide a spring Chinook fishing season for both Indian and non-Indian fishers.

A lot of hard work has been done to restore stream flows in the Deschutes Basin. Approximately 128 cfs has been placed back instream through various conservation practices and the reduction of out-of-stream uses. Many irrigation districts in the basin have either lined many miles of open canals or replaced them with pipes, which means less water diverted and more water instream. The Deschutes River Conservancy has worked with five irrigation districts on such projects, resulting in 54 cfs of permanently protected streamflow in the Deschutes River and its tributaries. Restoring stream flows in the Deschutes Basin has been a success in large part to the cooperative efforts of very diverse interests and stakeholders working together to balance the needs of urban, rural, and ecosystem needs.

In 2009, the Savage Rapids Dam was removed from the Rogue River. Once used as an irrigation diversion dam, Savage Rapids stood 39-feet high with a 500-foot long range across the Rogue River, 5 miles upstream of Grants Pass. Known as "the biggest fish killer on the Rogue River," the dam denied access to 500 miles of fish spawning and rearing habitat.

The dam removal project, which spanned over two decades, involved entities at the local, state, and federal levels: WaterWatch of Oregon, US Fish and Wildlife Service, National Marine Fisheries Service, Oregon Water Resources Department, Oregon Department of Fish and Wildlife, US Bureau of Reclamation, and Grants Pass Irrigation District. Significant funding for the project came from the Oregon Watershed Enhancement Board and the federal government. The result of this joint effort has many benefits, including the protection of 800 cfs of water instream. With the dam removed, fish now have access to habitat for the first time since the dam's construction in 1921. Boaters and river recreationalists have opportunities to enjoy the river in new ways. The local economy and fishing industry will also benefit in future years.

Salmon in the Pacific Northwest evolved in highly variable environments to develop life histories, behavior, physiological characteristics, and genetic diversity that result in highly resilient populations that have the capacity to re-colonize vacant habitats. Maintaining sufficient water quality, water quantity, and desirable habitat characteristics are essential components of salmon conservation and recovery efforts. Oregon Department of Fish and Wildlife spawning ground surveys conducted in 1997 showed that Oregon Coast Coho salmon occupied just 16 percent of potential spawning habitat. By 2003, a combination of improved ocean conditions, natural stray rates, and efforts to maintain or improve habitat led to the occupation of more than 80 percent of potential spawning habitat. More than 75 percent of the sites that were unoccupied in 1997 had spawning Coho in 2003. It is no doubt that efforts to restore habitat and streamflow are having a positive effect on Oregon's ecosystems.

Conclusion

Oregonians' interest in maintaining ecological services has resulted in developing public policies that increase efforts and demand to maintain healthy ecosystem services. These policies rely on voluntary efforts as well as

laws and regulations. In turn, this interest in healthy ecosystems has provided economic opportunities to landowners and managers to provide these needed ecological services through restoration and conservation projects on their land. Oregon's ecological health is not only a matter of aesthetic or recreational benefits, but also a matter of vital economic importance.

It is time for Oregon to plan for, preserve, and enhance its ecosystems through integrated planning. Ecosystems and the services and value they provide are inextricably linked to land-use, water use, and water quality. Water plays a vital role in almost every type of ecosystem from deserts to rain forests. Because land use and habitat management affects the quantity and quality of water, both above and below ground, Oregon needs a strategy that addresses water quantity, quality, and habitat, not only to acknowledge ecological realities, but also the legal realities at issue, including state water law, the Clean Water Act, and the Endangered Species Act, to name a few.

Sources

Bryden, Gregg. "Ecosystems Markets Conference 2009: A Year of Progress." *Oregon Insider.* Envirotech Publications Inc., August 2009.

Cone, Joseph, Oregon Sea Grant and Oregon State University. *Coho Salmon: Life in the Watershed.* 1999

Deschutes River Conservancy, Water Conservation Program: Permanent Streamflow Protection webpage, accessed 9/10/2010. www.deschutesriver.org

Furniss, Michael J.; Staab, Brian P.; Hazelhurst, Sherry; Clifton, Cathrine F.; Roby, Kenneth B.; Ilhadrt, Bonnie L.; Larry, Elizabeth B.; Todd, Albert H.; Reid, Leslie M.; Hines, Sarah J.; Bennett, Karen A.; Luce, Charles H.; Edwards, Pamela J. 2010. Water, *Climate Change, and Forests: Watershed Stewardship for a Changing Climate*. Gen. Tech. Rep. PNW-GTR-812. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 75 p.

House Bill 3369 (2009) is available at: http://www.leg.state.or.us/09reg/measpdf/hb3300.dir/hb3369.en.pdf

Hubler, S., S. Miller, L. Merrick, R. Leferink, A. Borisenko. 2009. *High Level Indicators of Oregon's Forested Streams*. Oregon Department of Environmental Quality, Laboratory and Environmental Assessment Division, Hillsboro, Oregon. 77 p.
http://www.oregon.gov/ODF/indicators/docs/High_Level_Indicators_DEQ09_LAB_0041_TR.pdf

Institute for Natural Resources. 2009a. *Management of Stream Systems in an Ecosystem Dynamics Framework.* Recommendations from the February 17, 2009 seminar.
http://egov.oregon.gov/ODF/RESOURCE_PLANNING/docs/INR_Aquatics_White_Paper.pdf

National Oceanic and Atmospheric Association (NOAA). *Endangered and Threatened Species Under NMFS' Jurisdiction*. http://www.nmfs.noaa.gov/pr/pdfs/species/esa_table.pdf.

National Oceanic and Atmospheric Association (NOAA). *Endangered Species Act Status of West Coast Salmon & Steelhead*. July 1, 2009. http://www.nwr.noaa.gov/ESA-Salmon-Listings/upload/snapshot-7-09.pdf.
Oregon Coastal Atlas, About Estuaries in Oregon.
http://www.coastalatlas.net/index.php?option=com_content&task=view&id=1&Itemid=9

Oregon Department of Agriculture. *Conservation Reserve Enhancement Program.*
http://www.oregon.gov/ODA/NRD/water_crep.shtml

Oregon Department of Forestry. Fish Screening Program (status and challenges). For more information, visit: http://www.dfw.state.or.us/fish/screening/

Oregon Department of Fish and Wildlife. *Oregon Native Fish Status Report, Volume 1.* 2005. http://www.dfw.state.or.us/fish/ONFSR/final/A-Vol%201%20Introduction.pdf.

Oregon Department of Fish and Wildlife. *The State Conservation Strategy and Six Key Conservation Issues, Goals, and Actions.* 2006. http://www.dfw.state.or.us/conservationstrategy/.

Oregon Department of Forestry. *Board of Forestry Private Forestlands Draft Issue Paper.* June 3, 2009.

Oregon Department of Water Resources. *2008-09 Key Performance Measures.* http://www1.wrd.state.or.us/pdfs/OWRD_Annual_PM_Report_2009.pdf

The Oregon Estuary Plan Book, Estuaries in Oregon http://www.inforain.org/oregonestuary/index.html

Oregon Forest Resources Institute. "Forest Overview." http://oregonforests.org/FactsAndResources/ForestFacts.html

Oregon Forest Resources Institute. "How Do Forests Affect Our Drinking Water?" http://oregonforests.org/assets/pdfs/Fact_Drinkingwater_web.pdf

Oregon Invasive Species Council, Frequently Asked Questions website, http://www.oregon.gov/OISC/faqs.shtml

Oregon State University, University of Idaho, Washington State University, University of Alaska. "Taking Care of Streams in Washington, Oregon, Idaho, and Alaska: A Recreationist's Guide to Riparian Areas." 2002. http://extension.oregonstate.edu/catalog/pdf/pnw/pnw561.pdf

U.S. Environmental Protection Agency. *Oregon 2006 Water Quality Assessment Report.* http://iaspub.epa.gov/waters10/attains_index.control?p_area=OR.

U.S. Fish and Wildlife Service. *Species Listed in Oregon Based on Published Population Data.* http://ecos.fws.gov/tess_public/pub/stateListingIndividual.jsp?state=OR&status=listed.

Virginia Polytechnic Institute and State University. *Pesticides and Aquatic Animals: A guide to Reducing Impacts on Aquatic Systems.* Publication 420-013. 2009.

Portland State University, Center for Lakes and Reservoirs. *Oregon Aquatic Nuisance Species Management Plan*, June 2001. Produced by Erik Hanson and Mark Sytsma.

State of the Environment Report (SOER), 2000.

Good, James W., Oregon Sea Grant, Oregon State University. Chapter 3.3: Summary and Current Status of Oregon's Estuarine Ecosystems. http://www.oregon.gov/DSL/WETLAND/docs/soer_ch33.pdf?ga=t

Gregory, Stan, Oregon State University, Department of Fisheries and Wildlife. Chapter 3.5: Summary and Current Status of Oregon's Riparian Areas. http://oregon.gov/DAS/OPB/docs/SOER2000/Ch3_5.pdf

Morlan, Janet C. Oregon Department of State Lands. Chapter 3.4: Summary of Current Status and Health of Oregon's Freshwater Wetlands. http://www.oregon.gov/DSL/WETLAND/docs/soer_ch34.pdf

WaterWatch of Oregon. Summary of Savage Rapids Dam Removal History. Accessed Oct. 25, 2010 via website:
http://waterwatch.org/programs/freeing-the-rogue-river/Savage Rapids Dam Removal Summary.PDF

Economic Development

The purpose of this issue paper is to discuss the linkage between water and Oregon's economy. The discussion focuses on the major business segments and activities that rely on clean and adequate water supplies to prosper and maintain a presence in Oregon.

Agriculture

A 2008 water demand forecast commissioned by the Water Resources Department notes that irrigated agriculture uses more than 85 percent of the water that is diverted in Oregon. Of that, the largest demand (66 percent of agricultural demands) is in the eastern and southeastern counties of the state where large irrigated areas exist. These include Malheur, Lake, Baker, Klamath, Harney, Umatilla, and Morrow counties.

Oregon's economy relies heavily on the viability of its agricultural sector, generating $25.8 billion to Oregon's economy, or 10 percent of the state's economic activity. In Oregon, agriculture represents nearly $5 billion in farm gate value (farm gate refers to the value of the crop or livestock when it leaves the farm, minus any marketing cost incurred). There are 14 commodity categories that represent annual sales of at least $100 million each, with nursery crops representing the leading sector in terms of value at nearly $1 billion. One of every 10 jobs in Oregon is associated with the agriculture/food industry.

Agriculture in Oregon depends greatly on water delivery for crop use and farm production activities. Specifically,

- About 78 percent of Oregon's agricultural irrigation water comes from rivers and streams, fed by snow pack runoff.
- Nearly two million acres of Oregon agriculture is irrigated and nearly 45 percent of Oregon farms irrigate some or all of their land.
- Oregon ranks third of all states in the number of farms that use irrigation, and ninth of all states in the number of acres irrigated.
- Irrigated farms produce 77 percent of the total value of harvested Oregon crops.
- Virtually all fruits and vegetables grown in Oregon are produced with irrigation.
- Yields of other crops, including grains, can increase up to 500 percent with irrigation.

~Oregon Dept. of Agriculture, 2010

Food Processing

Oregon's 200 food processors account for an additional $3 billion in value-added sales revenue. According to the Oregon Business Plan Agriculture Cluster data, nearly 17,000 workers are employed in Oregon's food processing sector, generating a payroll of more than $500 million annually. Food processors play an essential part in food production by freezing, cooking, packaging, and transforming produce into other product forms for consumers. As the third largest manufacturing sector in Oregon, it is no surprise that the food processing industry handles a variety of crops, from cherries to onions, and includes many companies that specialize in bakery items, dairy products, other fruits and vegetables, meat, poultry, and seafood. Food processing is a water intensive industry because of the vast amounts of water required to wash and process the food. Finding a fresh water supply to support and meet the needs of this industry is a challenge.

Recreation and Tourism

Tourism is important to Oregon's economy, particularly on the Oregon Coast and in Central and Eastern Oregon. There are many recreational activities and tourist attractions where the focal point is a lake, river, stream, a snow-covered mountain, or the ocean. Water resources in Oregon offer many recreational opportunities, such as boating, kayaking, rafting, canoeing, camping, hiking, fishing, and observing wildlife, which greatly contribute to Oregon's economy. Some highlights:

Boating and Fishing. Nearly 3 million boat-use days. A "boat use day" is any portion of a 24-hour period in which a participant is engaged in boating activities. Fishing remains the highest use activity for boaters at 63 percent of all activity days. According to the American Sportfishing Association, in 2006, there were 7

million fishing days spent by resident and non-resident freshwater fishermen and 846,000 fishing days spent by resident and non-resident saltwater fisherman, which generated nearly $454 million in retail sales and provided approximately 8,000 related jobs in Oregon.

Water Sports: sailing, waterskiing, and wakeboarding have declined about 20 percent since 2004, while non-motorized boating such as kayaking, rafting and canoeing have continued to increase. These activities involved an estimated 386,000 people in Oregon in 2005 according to an Outdoor Industry Foundation report.

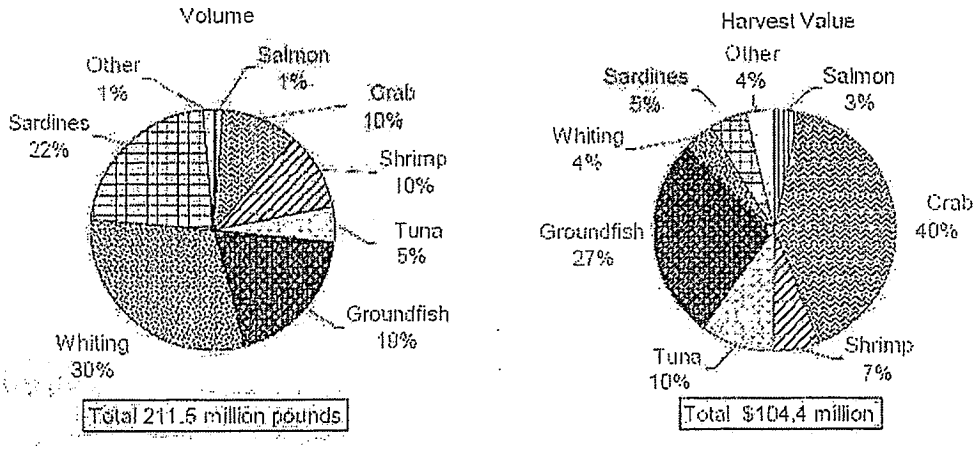
Fish and Wildlife Recreation: In 2008, nearly 2.8 million Oregon residents and nonresidents participated in fishing, hunting, shellfishing, and outdoor recreation focused on wildlife viewing throughout Oregon, resulting in expenditures of $2.5 billion. These expenditures include transportation expenses, accommodations, recreational fees, food and beverage services, and equipment purchases. Many Oregon counties, such as Harney, Lake, Morrow, and Wheeler County, receive a significant boost to their local economy from those willing to travel to participate in fish and wildlife recreation activities. The economic value of fish and wildlife recreation adds to the importance of protecting Oregon's water instream for continued enjoyment. Invasive species, changes in land-use, and habitat loss threaten our opportunities for fish and wildlife recreation.

Camping. There are hundreds of day-use parks and overnight camping facilities in Oregon, many of which reside along scenic rivers and lakes. The Oregon Department of Parks and Recreation manages more than 360 properties that include day-use areas and overnight camping facilities available for public use. In 2009, more than 2.5 million people stayed overnight and 41 million people visited day-use areas. Oregon ranks among the nation's top ten in state park overnight and day-use attendance. Not only are people willing to pay to visit and stay in these parks, many Oregonians volunteer thousands of hours a year to help maintain park lands and facilities (In 2009, there were 497,537 volunteer hours). Combining visitor expenses for both state and federally managed parks, visitors spent $222 million on travel-related expenses to use public campground facilities in 2009.

Commercial Fisheries

In 2009, more than 211 million pounds of fish were delivered to Oregon ports. The harvest value of Oregon onshore landings was $104.4 million. The estimated total personal income generated by the Oregon commercial fishing industry in 2009 was $398 million, supporting an estimated 12,000 jobs. The Dungeness crab fishery dominates the commercial fishing industry, accounting for more that 40 percent on the onshore landing harvest value. The industry is facing pressures that limit access, such as the need to protect ocean areas for marine research and wave energy. Competition among other user groups (recreational and tribal fishing), can affect the allocation of commercial harvests. Increasing costs for fuel, safety equipment, insurance, and moorage are also burdening the industry.

Figure 12: Oregon Onshore Landed Volume and Harvest Value by Species Group in 2009



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Municipal Use

Municipal water providers deliver a variety of benefits on behalf of the public, serving as a backbone of economic development in many communities. Examples of benefits include protecting public health and safety by providing water in the necessary quantities and pressure to allow for fire suppression; and support for the local economy is achieved by delivering a reliable supply of water that is used in all facets of providing goods and services. In addition to these responsibilities, municipal water suppliers have one thing in common — the need to continually plan for their system's development.

Municipal suppliers (cities and districts) are formed by a vote of the affected people to provide services. Municipal suppliers can function as independent special districts or as part of larger cities. Municipal systems deliver potable drinking water supplies, and typically have their own source of funding (ratepayers). The municipality is duty-bound to serve all citizens and customers who locate within the boundary. Municipalities cannot wait to see how growth occurs. They can only make good-faith predictions of what growth might occur and be ready to serve that need before it occurs.

Municipal systems in Oregon account for about six percent of diverted water, according to a 2008 water demand forecast completed for the Water Resources Department. The largest municipal demands are in Multnomah, Washington, Clackamas, Lane, Jackson, Marion, and Deschutes Counties, which have the fastest population growth rates in the state. These same counties are projected to continue to have the greatest increase in municipal water demand through the year 2050.

DHS' Drinking Water Program partners with the Oregon Business Development Department to administer and carry out the State Drinking Water Revolving Fund (SRF). The SRF program is funded with annual capitalization grants from the U.S. Environmental Protection Agency (EPA) and is aimed at helping communities construct safe drinking water projects. These SRF projects are considered small-to-medium in size and do not typically include large, regional projects. The EPA released a February 2009 report, calculating a total drinking water infrastructure need in Oregon of $2.8 billion over the next 20 years. The Oregon Business Development Department conducted an older survey (February 2008) for the Oregon Legislature, identifying a $500 million need for drinking water infrastructure for 116 Oregon communities over the next 20 years, <u>not</u> including population growth.

Manufacturing

While many manufacturers purchase their water from the municipalities described above, others "self supply" their own water. Self-supplied manufacturers represent approximately six percent of water diverted in Oregon, and are located in counties that have population centers that can provide the work force and ports to support such industries.

Manufacturing plays a prominent role in Oregon's economy; its annualized growth rate of 10.7 percent between 2003 and 2007 helped solidify its position as the largest single contributor ($30.2 billion) to Oregon's 2007 $138.9 billion private sector gross domestic product.

Computer and electronic products, wood products, and food manufacturing account for almost half (46 percent) of Oregon's private sector manufacturing employment (203,242) in 2007. The high tech manufacturing sector, the focus of intense recruiting efforts in Oregon, is a water-intensive industry because of the volume of water required for cleaning and cooling. (One of the largest semiconductor chip manufacturers in Oregon reports the use of almost 10 gallons of water – much of it recycled – to produce a semiconductor chip one square centimeter in size.) In addition, the highly toxic chemicals used in the manufacturing process pose challenges for wastewater treatment processes and disposal.

Transportation

Several ports in Oregon serve as water-borne cargo ports for ocean-going vessels as well as for barges traversing the Columbia River. For example, the Columbia River is the United State's largest wheat export system. Oregon's ocean ports, located in Portland, Coos Bay, Astoria, and Newport, serve as international gateways for imports and exports of numerous products. Oregon's manufacturing, agricultural, and commercial fishing industries rely heavily on Oregon's ports as they all have economic ties to overseas customers in Asia, South America, and other overseas locations. A substantial number of Oregon's jobs are directly or indirectly dependent on Oregon's port system. Maintaining Oregon's waterways for shipping purposes is greatly affected by sedimentation. Deepening a river channel is sometimes necessary to facilitate transportation of today's larger vessels, however, the process can be extremely expensive.

The Water – Energy Nexus

Water resources and energy resources are interdependent. In many cases, energy is required to divert, treat, and distribute surface water and groundwater. Water, in turn, is required for energy production. Power plants, such as natural gas and coal products are often sited near streams because they require water to cool their facilities. In Oregon, water resources have their greatest impact on the energy economy when they power hydroelectricity.

Hydropower. Oregon and the Pacific Northwest are heavily dependent on hydroelectric generation for energy supplies. According to Oregon Department of Energy's *Renewable Energy Action Plan* (2005), hydropower meets about 44 percent of Oregon's electricity demands. Small public utilities rely on the Bonneville Power Administration (BPA) to deliver relatively inexpensive power generated at federal dams to keep power rates among the lowest in the nation, while large public utilities and private utilities may own and operate their own large-scale hydropower dams and receive secondary power benefits from BPA.

Most large-scale hydroelectric development occurred in the 1940s through the 1960s. Since that time, there has been a recognition that the river ecosystems that fuel this energy source can no longer withstand large-scale development. This recognition spurred action at the state and federal level to protect and restore rivers from the physical, chemical, and biological degradation caused by hydropower development. The effect? Water power development has evolved toward small-footprint localized hydropower, using existing water delivery systems or existing dams.

By storing water, hydropower dams can act as a battery for our energy grid, generating power at the time that we need it, matching the peaks and curves of our daily energy needs. Hydropower's unique ability to shape its generation to our load makes it an extremely valuable companion fuel source. In Oregon, hydropower serves as base load, balancing out the intermittency of current wind power and new wind power coming online in eastern Oregon.

Wave Power. Ocean energy is also a promising new sector for Oregon. The Oregon Business Development Department has named wave power as a key initiative and has funneled significant financing through the Oregon Wave Energy Trust. At this time, only test buoys are permitted to deploy from Oregon's coast. The passage of Senate Bill 195 (2009) authorized the first wave energy project to connect to the power grid. The Department of Energy offers special tax credits and low-interest loans and grants for this renewable power resource.

Bioenergy. Oregon's bioenergy industry is a diverse and growing industry. Facilities in Oregon include woody biomass co-generation facilities, lumber mills utilizing wood for energy, anaerobic digester facilities installed at wastewater treatment facilities and farms, solid fuel manufacturers and liquid biofuel producers. The use of biofuels can help protect air quality through lower emissions of particulate matter, hydrocarbons, sulfates and other toxics. With gains in efficiency in recent years, the production and use of

biofuels can reduce our energy demands. Biofuels are biodegradable and pose little risk of directly contaminating water. However, biofuel production can negatively impact water quality, from fertilizer runoff, pesticide use, and soil erosion. Negative impacts to water quality can be minimized through best management practices, such as cover crops, rotational plantings, maintaining stream buffers, and integrated pest management. Lastly, biofuel production is generally water intensive. Ethanol plants use large amounts of water for cooling and wastewater discharge purposes, although design improvements have been made in the last 10 years to reduce water use.

Mining

Oregon's mining industry is vital to the state's economy. Aggregate is the most widely used building material in Oregon, over timber, steel, plastic, or glass. It can be sand, gravel, or crushed rock, all of which are needed to construct roads, build foundations, buildings, and other structures. In 2007, there were more than 300 mining operations in the state, providing a total of 12,330 jobs with total direct earnings of $140 million. Mining in the state account for 0.1 percent of the state's gross domestic product. The majority of mining sites in Oregon are aggregate sites, with gravel extraction commonly occurring along rivers in Western Oregon.

Like many industries, water is used as an input in mining operations for crushing, screening, washing, and for the extraction of minerals. The removal of water, particularly groundwater, is an essential part of resource extraction in many operations. According the U.S. Geological Survey, mining activities accounted for 0.2 percent of water used in Oregon during 2005. Larger gravel bars in rivers and streams have also been a source of aggregate since the early 20th century; however, in-stream gravel removal is decreasing due to the need to protect fish species and spawning habitat.

Conclusion

Access to reliable and clean water is directly tied to the health of Oregon's economy and way of life. The demand for water, both in terms of quantity and quality, varies between industries due a number of factors that include the efficiency of the water system, operational methods, and the multitude of products and services that use water, from agricultural goods to computer products. Because of this variability, the Integrated Water Resources Strategy should consider water and wastewater issues on an industry-by-industry basis. In the future, water could increasingly be a defining factor – and also a competitive advantage - if Oregon manages its water resources well.

Sources

Columbia River Channel Coalition. *The Columbia River Channel Deepening Project Overview.* http://www.channeldeepening.com/

Dean Runyan Associates. *Fishing, Hunting, Wildlife Viewing, and Shellfishing in Oregon. 2008 State and County Expenditure Estimates.* Prepared for Oregon Department of Fish and Wildlife and Travel Oregon, May 2009.

National Mining Association. *The Economic Contributions of Mining in 2007.* Analysis by Moore Economics, February 2009.

Oregon Business Plan. *"Keeping Focus in Tough Times" Summit.* December 2008

Oregon Business Plan. *About Oregon's Industry Clusters: Tourism* http://www.oregonbusinessplan.org/Industry-Clusters/About-Oregon%E2%80%99s-Industry-Clusters/Tourism.aspx

Oregon Department of Fish and Wildlife, January 2010 Briefing Report: *Oregon Commercial Fishing Industry Preliminary Economic Contributions in 2009.* http://www.dfw.state.or.us/fish/commercial/docs/OR_Comm_Fish_Ec_Impacts_Prelim_2009.pdf

Oregon Department of Energy. *Biofuels Impact Study, Report to the Oregon Legislature.* August 2010.

Oregon Department of Energy. *Oregon's Renewable Energy Action Plan.* Prepared for Governor Ted Kulongoski. 2005. http://www.oregon.gov/ENERGY/RENEW/docs/FinalREAP.pdf?ga=t

Oregon Department of Geology and Mineral Industries. Mineral Land Regulation and Reclamation Program Overview. Accessed online, September 2010.

Oregon Department of Land Conservation and Development, Oregon Department of Transportation. *Planning for Aggregate. A guide to planning for aggregate resources in Oregon.* November 2001

Oregon Department of Transportation. *Relationship of Freight Transportation to Economic Development.* Prepared by Parsons Brinkerhoff Team. June 2009.

Oregon Environmental Council. *Fueling Oregon with Sustainable Biofuels.* October 2007.

Oregon State University Extension Service. *A Snapshot of Salmon in Oregon: Mining.* 1998.

Oregon State University, Rural Studies Special Report 1080. *Oregon Agriculture and the Economy.* February 2008.

Oregon Business Development Department, Bureau of Economic Analysis, March 2009

Oregon Business Development Department, Innovation and Economic Strategies Division

Oregon Employment Department, Bureau of Labor Statistics, March 2009

Oregon Economic and Community Development Department Cogan Owens Cogan Report June 30, 2005

Oregon Travel Impacts Report (posted April 2008)

Oregon State Marine Board survey, 2008

State Board of Agriculture. State of Oregon Agriculture Industry Report. January 2009.

U.S. Geological Survey. Oregon Water Use Program. *Withdrawal Compilation Totals for Surface Water and Groundwater in Oregon.* 2005.

Culture, Community, and Water

The purpose of this paper is to discuss how water influences the culture and way of life in Oregon. The role water plays, how Oregonians view and use it, differs depending upon its availability, quality, and our needs. Water plays a major role in Oregon's agricultural, tribal, rural, urban, and coastal communities. Each community faces a different set of challenging water resource issues. Some communities struggle to meet their basic domestic needs, whereas others have the luxury of safe and abundant supplies. Developing a strategy can help to foster public health, safety, and education related to water. It is important to recognize that needs and solutions will differ among regions, and within communities. Improving the understanding of Oregon's water needs, and the pressures that affect those needs (population growth, land use, climate change) will help satisfy today's needs, and prepare for the needs of future generations. Lastly, ensuring that communities have the best technical information available to them to improve participation and decision-making

Background

All living things need water. People, animals, and plants will live and thrive where water is available and abundant for them to function through their life cycle. Water is an underpinning for our own quality of life. Humans use water to bathe, wash clothing, prepare meals, and to replenish our bodies. Tribal and religious communities view water as a cultural resource and use water within ceremonial activities. Water provides for many recreational needs, such as fishing, rafting, kayaking, swimming, and wildlife viewing. Many aesthetic pleasures are also dependent on water - watering lawns, washing cars, filling swimming pools, and simply enjoying the landscape that water features provide. Understanding a community's need for water, *use* of water, and *view* of water will help the state develop solutions to meet their water needs.

Determining "need" for water versus "demand" for water will be important for developing solutions. These terms have very different meanings and implications at the household level, the city level, the watershed level, and at the state level.

A lack of water can have a devastating effect on the cultures and livelihoods of those who depend on it. Without sufficient water, competition between water users can increase, which means the economic value and cost of water may also increase. As one example, policy skirmishes that curtailed federal project irrigation water in the Klamath Basin decimated agricultural production and the communities that depend on this agricultural income, and then endangered fish populations and the Indian Tribes, and commercial and recreational fishing industries that depend on healthy fish runs.

Use of Water. In Oregon, a water user has the flexibility to use water for any activity allowed under a water right. During the past century, the state has issued water rights for many uses, some of which include: agricultural use, irrigation, domestic and livestock use, power development, commercial use, municipal, and instream uses for fish, wildlife, recreation, and pollution control.

When surface water and groundwater supplies are scarce, the state distributes water based on the seniority of the water right.

Water Use in Oregon

Water use in Oregon is typically described in broad terms, such as "irrigation use" or "municipal use." However, water use is quite diverse and includes:

- Temperature Control
- Frost Protection
- Cranberry harvesting
- Forest management
- Fire Protection
- Riparian Habitat Restoration
- Wetland Construction
- Air Conditioning or Heating
- Anadromous and Resident Fish Habitat
- Fish Hatcheries
- Road Construction
- Nursery Operations
- Food Processing
- Camp Site Facilities (restrooms, showers, water fountains)
- Dairy Barn Purposes
- Manufacturing
- Pollution Control
- Aesthetics

Many municipal water providers and irrigation districts offer conservation programs to help their customers become more efficient and decrease their overall water use. Under certain emergency situations, individual water right holders, such as municipalities or irrigation districts, can implement their own curtailment plans that impose even further restrictions on their own customers. In the case of municipalities, one example of this could include the prohibition of outdoor uses such as watering lawns, washing cars, or running water features. In a Governor-declared drought declaration, the Governor has additional tools available to restrict water use to essential uses, such as drinking and stock watering.

The Role of Water in Oregon

Water quantity, water quality, ecology, economy, and climate change issues touch every community in Oregon. These water issues cut across all citizens in Oregon, as water is an integral part of daily life in many social, cultural, and economic ways. Managing water in a sustainable and balanced way to meet our many needs is important to the health of our communities.

Tribal Communities. Many cultures use water in their rituals, ceremonies, and other activities. Important cultures that bear particular attention in Oregon are the Indian Tribes, which are recognized as sovereign nations. Oregon has nine federally recognized Indian Tribes throughout the State. Legally binding treaties, federal statutes, and numerous court decisions explicitly or implicitly acknowledge the central role water and related resources play in promoting the effective self-determination and self-governance of tribal nations because they form the base of the tribal cultural and natural resources pyramid. From the tribal perspective, natural and cultural resources were plentiful and in a healthy condition during the 10,000 years of history, prior to the formation of the State of Oregon 150 years ago.

Protecting Cultural Resources

By law, the State of Oregon is steward of the state's cultural resources and considers archeological sites as irreplaceable, finite, and a direct contribution to Oregon's heritage. A significant number of archaeological sites and sacred sites are located on or near waterways and water bodies within the State. The excavation, destruction, or alteration of any archaeological site or collection of objects on public or private lands is prohibited without the proper permit or landowner permission.

For most tribes, cultural resources include traditional culture and the resources needed to sustain that culture. It is not limited to historical or archeological sites, or to the tribes ceremonies and traditions. Cultural resources also includes native fish, wildlife, trees and plants, the habitat and watershed needed to sustain those, and ultimately, water itself.

Tribes need to be able to participate in and practice the traditions that define who they are as a people. Water is central to many of these traditions. As one example, elders teach young tribal members basket making techniques, which entail gathering grasses found in wetlands and pulling the grasses through their teeth to create basket string. If the water is polluted, the grasses and these traditional lessons may sicken both the tribal elders and their young students. As another example, tribal diets are heavily dependent on fish consumption, making water quality a fundamental concern of the Tribes. The quality of tribal traditions and diet depends on the quality of water in Oregon. As one tribal leader has noted, "the beginning and end of all life is *water.*"

Many tribal communities are actively working with partners to protect water quality and water quantity. The Confederated Tribes of Warm Springs (CTWS) has partnered with Portland General Electric to contribute $10 million toward watershed restoration and another $100 million to fish passage efforts. The Tribe has many interests in the protection of water quantity and quality, particularly in the Deschutes Basin, as they rely on water for domestic needs, fisheries, hydropower, habitat for traditional plants, wildlife, and other cultural and spiritual purposes. For the CTWS, water is considered sacred – it is the basis for all life.

Agricultural Communities. Oregon's economy benefits greatly from the agricultural community, which has been integral to Oregon's culture and way of life since statehood. In 2009, Oregon was home to nearly 38,600 farms, encompassing more than 16 million acres. Ninety-eight percent of farms in Oregon are family-owned or individually operated. More than 1,100 farms in Oregon have been family-owned for more than a century, according to the Oregon Department of Agriculture. The economic viability of many Oregon farms and ranches is heavily dependent on water. Water allows Oregon farmers to bring an incredibly diverse group of fruits, vegetables, and other crops to Oregon tables and families around the world.

Agricultural communities vary widely across the state, in terms of their size, average income, farm activity, and need for water. Take for example, the number of farms in three Oregon counties in 2007: Tillamook County – 302 farms; Sherman County – 208 farms; and Malheur County – 1,250 farms. The average net income per farm varies as well, from $101,512 for Tillamook farms, to $91,398 for Sherman County farms, and $40,309 for Malheur County farms. (USDA, 2007 Census) Cattle ranching and farming is the largest farming activity in Oregon, representing largest land-use activity in Oregon.

The variety and success within agriculture, from farm size to crop production, is partly attributable to its long history of water use in Oregon. The ability to use water to irrigate crops has led to well established agricultural communities across the entire state. Many large-scale irrigation projects, such as dams, diversion structures, and delivery systems (canals, ditches), were constructed during the early 20th century.

As the largest water user in Oregon, the agricultural community has a role in protecting water quality and water quantity. Activities, such as canal lining, piping, and replacing gravity diversions with pumps are taking place in parts of central and eastern Oregon. Use of drip irrigation is common in many agriculture applications, including nurseries, poplar plantations, vineyards, carrot seed production, and other row crops. To improve water quality, projects can include the construction of settling ponds, or wetlands to capture or filter irrigation runoff and the installation of pump-back systems. Many Oregon farm and ranch operations work closely with the Oregon Department of Agriculture and county Soil and Water Conservation Districts to meet water quality standards by managing animal wastes and non-point source pollution. In 2007, more than 1,700 farms in Oregon participated in federal conservation programs to protect water quality and conserve water (USDA, 2007 Census).

The Agricultural Community in Oregon is very diverse. This diversity allows us to enjoy a variety of commodities produced here in Oregon, some of which include:

Potatoes	Raspberries
Sugar beets	Loganberries
Wheat	Grass Seed
Apples	Nursery Plants
Blackberries	Christmas Trees
Blueberries	Hops
Cherries	Peppermint
Cranberries	Oats
Hazelnuts	Barley
Pears	Hay
Peaches	Peas
Plums	Corn
Prunes	Onions
Strawberries	Grapes
Milk	Tomatoes

~ USDA, Oregon Agriculture: Facts and Figures, June 2010

The cost of implementing various conservation measures can be a barrier to improving water efficiency, such as the electrical costs to pump water and distribution equipment costs (sprinklers, pumps, pipes, etc). This barrier not only affects the ability of agricultural communities to conserve water, but also affects municipalities, counties, cities and other water providers that are looking for ways to use water efficiently. The agriculture communities' dependency on water makes it highly susceptible to natural events, such as drought and change in precipitation patterns. Agricultural communities also face competition for water from both urban and rural development. Agricultural water needs also vary regionally, depending upon water availability, storage capability, and overall demand.

Rural Communities. In simple terms, a community is considered "rural" if there are less than 2,500 people, according to the U.S. Census Bureau. Rural communities vary across Oregon, differing in geographic and demographic characteristics, and as such, face a different set of pressures. A 2008 report by the Governor's Office of Rural Policy describes rural communities using four categories: Urban-Rural, Rural, Frontier Rural, and Isolated Rural. *Urban-rural* communities are slowly losing their agricultural base to increased development, which means additional municipal infrastructure demands. There is a struggle by some rural communities to finance water and wastewater infrastructure and system upgrades. *Frontier rural* communities are dependent on agricultural and other natural resources activities to sustain their local economies. Isolated rural communities are extremely self-reliant and dependent on volunteer services to protect public health and safety.

Typically, rural communities rely on groundwater, either through a small community water system or through individual wells that supply water to a single household. Isolated or individual use of groundwater makes it difficult for homeowners, business, and small water providers to address both water quantity or water quality issues. When the well output drops, most often a back up source of water to supply household needs is not available. Drilling a new well, or repairing an existing one, to increase supply can be extremely expensive to an individual user.

The assumption is often made that where the Water Resources Department has not specifically restricted development of the ground water resource, the resource is capable of sustaining additional water use. This assumption is often incorrect and land use decisions made pursuant to that assumption may exacerbate water supply problems by allowing additional water-dependent development. For these reasons, the Department and local land use planners must work together to prevent rural water supply problems.

Environmental Justice Communities. Environmental Justice is defined as equal protection from environmental and health hazards, and meaningful public participation in decisions that affect the environment in which people live, work, learn, practice spirituality, and play. In Oregon, environmental justice communities include minority and low-income communities, tribal communities, and other communities traditionally underrepresented in public processes. Through Senate Bill 420 (2007), twelve natural resource agencies are required to consider environmental justice implications within their programs. An Environmental Justice Task Force was formed in part to advise natural resource agencies on environmental justice issues and to define what issues the state is facing.

Some agencies have focused on environmental justice issues for many years now. For example, the Department of Environmental Quality adopted an environmental justice policy in 1997. Since then, the agency has been committed to the principles of environmental justice, ensuring that agency actions (i.e. permitting, cleanup, policy, planning, outreach and education, compliance and enforcement) address the interests of Oregon communities, especially minority, low-income and other traditionally underrepresented communities, as much as state and federal laws allow.

The Oregon Water Resources Department, Oregon Department of Agriculture, and the Oregon Department of Fish and Wildlife are also responsible for considering environmental justice issues. Collectively, these agencies have focused on engagement with tribal representatives, farmworker pesticide exposure, andextensive public outreach to stakeholders, small business owners, and members of the general public during policy formation.

Coastal Communities. Oregon's coastal communities comprise 186 miles of Pacific Ocean coastline and encompass nearly 60 public beaches. Many coastal communities are located in rural or sparsely populated areas. Approximately 210,000 people call the coast "home" full time. Coastal counties include Clatsop, Coos, Curry, Lincoln, Tillamook County, and portions of Douglas and Lane County. The five largest coastal communities are Astoria, Lincoln City, Newport, Coos Bay, and North Bend. Many coastal communities are

prime tourist destinations for recreational fishing and crabbing, sight seeing, and wildlife observation. Twenty-two major estuaries along the coast support communities by offering access for shipping, commercial fishing, port facilities, and recreational opportunities, along with many ecological benefits. Virtually all of Oregon's coastal rivers support anadromous fish species, such as salmon and cutthroat trout, many of which are listed under the Endangered Species Act.

Coastal communities depend on relatively small watersheds, where the streams are short, high gradient, and very seasonal, with low overall yields. Water use in coastal communities is seasonal as well, where demand dramatically increases during the summer tourist season. Domestic water use represents 35 percent of withdrawals, agriculture represents 30 percent, irrigation use 23 percent, and industrial use accounts for 12 percent. Agricultural use in the coastal areas include dairy farms for milk and cheese production, as well as cranberry operations on the south coast. Commercial and recreational fishing in coastal communities rely on abundant and healthy oysters, mussels, clams, salmon, halibut, ling cod, snapper, bass, Dungeness crab and scallops, which directly benefit coastal economies.

Coastal water systems rely heavily on surface water, rather than groundwater. To meet drinking water quality standards, communities often rely on treatment plants. Financing upgrades or expansions to water systems is a challenge in many communities. Outdated or undersized treatment facilities, combined with sewer outflows, are considered to be the greatest regional threat to coastal water quality. When coastal waters are unsafe for public use, the Department of Human Services issues a public health advisory that informs visitors what waters and activities to avoid, such as swimming, wading, or direct contact.

In recent decades, increases in population and development have placed a considerable amount of pressure on Oregon's coastal communities. There has also been an increase in the intensity and frequency of winter storms, resulting in significant damage to buildings and homes from flooding and erosion. These severe storms can also destroy water pipelines and diversion structures. Because of this, coastal communities are very vulnerable to climate change.

Metropolitan and Urban Communities. Metropolitan areas are often defined as communities with at least 50,000 people. The Portland Metro, Eugene-Springfield, Salem-Keizer, Medford, Bend, and Corvallis areas are considered metropolitan communities.

Metropolitan communities contain about 60 percent of Oregon's residents and are the location of most of state's population and employment growth. These areas have traditionally relied on surface water for domestic and other urban water needs and operate sophisticated infrastructure for managing and treating drinking water, wastewater and stormwater. The costs of managing these systems has become increasingly burdensome in recent years.

There are 69 cities in Oregon with a population over 2,500 (see "Rural Communities," above) that are not part of a metropolitan area (see "Metropolitan Communities," above) according to 2009 data. This is about 30 percent of Oregon's cities and 17 percent of the state's population. Urban communities vary across that state, differing in geographic and social characteristics. Most residents and businesses in these communities have the benefit of water and wastewater disposal service, either from the city or a district. There is a wide range of circumstances, however, related to growth and the jurisdiction's capacity to deal with development from a public facilities standpoint. *Add more description here...*

Public Health and Safety

Every community in Oregon has a responsibility to protect natural resources in such a way that ensures the health of its citizens. One of our most precious natural resources is water and keeping it safe and available is

key to protecting public health. The quality of our water also affects the food we consume, such as fish, oysters, clams and mussels. Water system operators in Oregon are instrumental in making sure the water that enters our homes is safe for consumption and use. Likewise, various state agencies, such as the Department of Human Services and the Oregon Department of Agriculture, help Oregonians determine when it is safe to eat fish and shellfish from Oregon's rivers, lakes and oceans.

Safe Drinking Water. On average, a person will consume more than a quart of water each day. Drinking water contaminants, such as bacteria, can cause acute health effects that generally occur within a few hours or days. Prolonged exposure of chemical contaminants, such as lead or arsenic, can cause cancer or organ damage.

Public water systems, with state oversight, are a key protector of public health. Approximately, 88 percent of Oregonians rely on community water systems as a primary drinking water source. These systems treat water to control pathogenic organisms, harmful contaminants, and constituents that affect the quality of the water. Traditionally, water treatment methods focus on particulate removal through flocculation, sedimentation, and filtration and include disinfection by using chlorine and ultraviolet technology. Often times, fluoride is added or harmful chemicals, such as arsenic, are removed, to protect public health.

In Oregon, public water systems with greater than three hookups or serving more than 10 people year-round are regulated. There are more than 3,500 public water systems in Oregon. Fifty-five of these public water systems serve 67 percent of the population. Oregon's public water systems are fed by more than 200 surface water diversions and almost 3,000 groundwater wells. Protecting the sources of water from contamination, combined with treatment, are both important components of protecting public health. Each year, drinking water providers must report the results of the mandatory water quality testing they perform on their potable water supplies. Since the 1970s, waterborne disease outbreaks in Oregon have fallen dramatically, from 15 in the 1970s, to two outbreaks during the 2000s because of the oversight and protection standards public water systems must meet.

Food Consumption. Many Oregonians consume locally caught fish and shellfish. Unfortunately, some of these species accumulate toxic chemicals, posing health risks to individuals that consume them. Shellfish, for example, can be contaminated by toxic algae blooms or sewage spills. The Oregon Department of Environmental Quality is the agency responsible for establishing the level of protection needed to ensure public health, through water quality standards. DEQ is responsible for defining the fish consumption rate that is safe for humans.

Over the last two years, DEQ has worked with partners and other agencies to revise the fish consumption rate with an understanding that Oregonians actually eat more fish and shellfish than previously thought. This process lead to adjusting the fish consumption rate to 175 grams per person per day, 10 times higher than the previous rate. As a result, DEQ has been working to revise human health water quality standards for toxic pollutants. Revisions to water quality standards, as a result of a higher fish consumption rate, will likely mean stricter limitations on pollutant discharge by industrial and municipal uses.

The Department of Human Services (DHS) also protects public health by issuing fish consumption advisories throughout the state's rivers and reservoirs. Most DHS issued advisories are for moderate to high mercury levels and PCB's (polychlorinated biphenyls). The Oregon Department of Agriculture and the Oregon Department of Fish and Wildlife jointly issue shellfish safety closures to protect recreational shellfish harvesters from consuming clams or mussels contaminated with harmful biotoxins.

Recreation. Public health and safety concerns associated with recreational use of lakes and other waters, has been growing over the past several years. When toxic algae blooms are detected in the water, activities such

as swimming, water-skiing, or any other direct contact with water should be avoided. The Oregon Department of Human Services, Oregon Department of Environmental Quality, Portland State University, Oregon State University, along with federal partners, have been working together to gain a better understanding of toxic algae blooms. Part of this work includes monitoring, public education and outreach, and informing the public regarding health and safety risks.

Barriers to Efficiency

Using water more efficiently (i.e., accomplishing the same task with less water) can manifest itself in a number of ways, including water conservation and water re-use. In 2008, the Water Resources Department surveyed water users to better determine the greatest barriers to increased water use. The most often-heard response was "cost," as re-tooling processes and systems often require a large capital investment up front. Other cost-related barriers can include higher energy bills, whenever electric pumps replace gravity fed delivery systems, or whenever drip irrigation systems replace flood irrigation or other methods.

Other barriers include fears of lost water rights. The adage "use it or lose it" is widely quoted in these instances. However, the Water Resources Department has a conservation program called "Allocation of Conserved Water," that allows water users to spread water over more lands and also place some instream, as part of a voluntary conservation program. Many water users are still unaware that such a program exists and those who have participated report that the process and paperwork can be difficult to maneuver.

Finally, there can be administrative barriers to water efficiency, as water conservation, water re-use and other techniques are still in development. Statutes and rules often lag behind these technologies, making implementation difficult.

Deteriorating Infrastructure

Deteriorating infrastructure is a universal problem. Water loss, public health concerns, combined sewer overflows, and inefficient systems typically result from such deterioration. Although many of Oregon's water, wastewater, and sewer systems are newer than their counterparts in the Eastern United States or Europe, they may still be more than a century old. Some older communities still have old wooden pipes in place underground. Barriers to infrastructure maintenance replacement include the capital investment required, as well as the inconvenience of digging up existing streets and pavement to lay pipes.

By some counts, Oregon is need of about $44 million in investments for public drinking water systems and about ten times that amount for wastewater and sewer systems. Although federal and state funds have historically helped communities meet some of these costs, a significant funding gap remains. *Add more detail on other infrastructure needs...*

Institutional Capacity

Placeholder

Barriers to Water Supply Development

Placeholder

Conclusion

It is sometimes easy to take for granted the abundance of clean water to drink, wash, recreate, and conduct business. If we do not pay attention to social aspects when we make decisions that affect water quality and water quantity, we can harm our cultures, our communities, and our livelihoods. And, since water knows no boundaries, a decision made upstream may have lasting direct or indirect detrimental effects on those persons

and communities downstream. As we move through the process of developing an integrated water resources strategy, we should continue to examine our social value of water, as well as the economic importance and ecological benefits it provides. As our Tribal partners have reminded us, we have a shared interest in the health, well being, and public safety of our state's waters.

Sources

Centers for Disease Control and Prevention, U.S. Environmental Protection Agency, National Oceanic and Atmospheric Agency, and American Water Works Association. 2010. *When Every Drop Counts: Protecting Public Health During Drought Conditions— a Guide for Public Health Professionals*. Atlanta: U.S. Department of Health and Human Services.

Crandall, Mindy and Bruce Weber. Oregon State University, Rural Studies Program. *Defining Rural Oregon: An Exploration*. November 2005
http://ir.library.oregonstate.edu/jspui/bitstream/1957/9262/1/RSP05-03.pdf

Oregon Board of Agriculture, *State of Oregon Agriculture Industry Report*. January 2009.

Oregon State Agencies. *Annual Report to the Governors Environmental Justice Task Force*. 2009.

Oregon Department of Agriculture. *Shellfish Safety Closures* (Website).
http://www.oregon.gov/ODA/FSD/shellfish_status.shtml - Most recent news release

Oregon Department of Environmental Quality. *Human Health Water Quality Criteria for Toxics Rulemaking, Work Plan Summary*. March 26, 2010 version.

Oregon Department of Environmental Quality. *Human Health Focus Group Report: Oregon Fish and Shellfish Consumption Rate Project*. June 2008.

Oregon Department of Environmental Quality. *Fact Sheet: Protection of Archaeological and Cultural Resources*. October 2007.

Oregon Department of Environmental Quality. *Introduction to Drinking Water Protection in Oregon*. Website:
http://www.deq.state.or.us/wq/dwp/intro.htm

Oregon Department of Human Services, Public Health Division. *Oregon Environmental Public Health Tracking, Public Drinking Water Quality (2002 – 2007), Nationally Consistent Data and Measures.*

Oregon State University. *Oregon Wave Action Resource Education, Economies of the Oregon Coast.*
http://ppgis.science.oregonstate.edu/?q=economies

Oregon State University, Rural Studies Program. *Rural Communities Explorer (Oregon Explorer Website).*
http://oregonexplorer.info/Rural/about/rural_issue.aspx?Res=17328

Oregon Water Resources Department, Oregon Department of Land Conservation and Development. *Groundwater Supplies in the Willamette Basin*. September 2002.

U.S. Department of Agriculture, National Agriculture Statistics Service and Oregon State University Extension Service. *Oregon Agriculture: Facts and Figures*, June 2010.

00003536

U.S. Department of Agriculture, National Agriculture Statistics Service. *The Census of Agriculture.* Oregon 2007 Census Publications, December 2009.
http://www.agcensus.usda.gov/Publications/2007/Full_Report/usv1.pdf

Surfrider Foundation. *State of the Beach: Oregon Water Quality.*
http://www.surfrider.org/stateofthebeach/05-sr/state.asp?zone=wc&state=or&cat=wq

U.S. Environmental Protection Agency, *Community Culture and the Environment: A Guide to Understanding a Sense of Place*, 2002, U.S. EPA (EPA 842-B-01-003), Office of Water, Washington, DC.

The Implications of Climate Change

The purpose of this issue paper is to explore the implications that climate change may have on water resources in Oregon. One important point to note is that while quite a bit of scientific work has focused on the Pacific Northwest there is very little information available that relates to Oregon specifically. More research is required to understand how Oregonians, our water supplies, and our environment will be affected by climate change over the decades to come. The Water Resources Commission identified this as an important emerging issue for the state and adopted its initial climate change policy in February 2009. The strategy serves as an opportunity to develop reasonable adaptation strategies now, while at the same time continuing research to advance scientific knowledge relative to climate change.

Background Information

Studies and Partnerships. There are many institutions, local – state – and federal, that are conducting studies on climate change. The Oregon Climate Change Research Institute (OCCRI) has been tasked by the Oregon Legislature to foster climate change research among faculty of the Oregon University System. OCCRI/Oregon State University was recently awarded a grant, which could surpass $3.5 million, from the National Oceanic and Atmospheric Association to address climate assessment needs for businesses, state and federal agencies, municipalities, tribal leaders and non-governmental organizations in the Pacific Northwest.

The Climate Leadership Initiative is a social science-based global climate change research and technical assistance collaborative between The Resource Innovation Group and the Institute for a Sustainable Environment at the University of Oregon. For the past four years, the Climate Leadership Initiative has been implementing a series of Climate Future Forums and Watershed Resiliency Trainings across Oregon's river basins. The goal of these programs is to develop models for building climate resiliency and adaptation literacy, while also delivering the tools and resources needed to assist all levels of governments, the private sector, and nonprofits to proactively prepare for climate change.

In July 2009, the Land Conservation and Development Commission adopted an interim climate change strategy that directs the Oregon Department of Land Conservation and Development to begin working on a framework for a state-level climate change adaptation plan for Oregon's built environment, and to coordinate that work with other efforts already underway in other Oregon agencies. The intent of this effort is to identify: (1) likely future climate conditions and the risks those conditions represent for resources, infrastructure, and communities; (2) actions agencies are taking to address those risks; (3) gaps in state capacity to address those risks; (4) priority short-term actions to address those gaps; and (5) some basis for identifying longer-term priority actions.

The consensus among climate scientists is that climate shift is occurring more rapidly than can be attributed to natural causes and that significant impact to the environment will be felt in this century. For instance, the annual average temperature over the Northwest United States (Oregon, Washington, Idaho and western Montana) is projected to rise 3 to 10 degrees Fahrenheit during this century (visit www.globalchange.gov/usimpacts). Another critical impact will be the changes in precipitation patterns in the western United States. This will affect water availability, not just for agriculture and food production, but also for the most basic drinking water and domestic water needs of communities in many areas. Impacts related to changes in snowpack, stream flows, sea level, forests, and other important aspects of life in the Northwest are already visible, with more severe impacts expected over the coming decades in response to continued and more rapid warming.

Potential Consequences of Climate Change

Declining springtime snow packs could lead to reduced summer streamflow, straining water supplies. Oregon and all the Northwest is highly dependent on temperature-sensitive springtime snowpack to meet

growing and often competing water demands such as municipal use, industrial use, irrigation for agriculture, hydropower production, navigation, recreation, and instream flows that protect aquatic ecosystems including threatened and endangered species. Higher temperatures are causing more winter precipitation to fall as rain rather than snow and are contributing to earlier snowmelt. Further declines in snowpack are projected, reducing the amount of water available during the warm season. The amounts of flow reduction, for a given amount of warming in winter or spring, are highly variable from one part of the state to another, depending in part on the mean elevation of the river basin in question.

Most climate models suggest that amounts of winter precipitation will continue to arrive—but as rain rather than snow. **Figures 13a and 13b** show the percentage of precipitation that falls as rain in two scenarios, conditions today and conditions with a rise in temperature. If temperatures increase 3 degrees, the percentage of precipitation that falls as snow is visibly less (**Figure 13b**).

Snow Today. *Snowpack, stored naturally during the winter and melting slowly during the spring, represents a significant source of water for all types of uses and functions. We rely on snowpack to recharge streams and reservoirs, to provide cold water for fish habitat and overall stream health, and to provide water supplies to agricultural, industrial, municipal, and other uses in the late spring and summer.*

Rain Tomorrow. *Climate change models predict warmer temperatures in the coming decades, potentially changing precipitation that normally fell as snow to rain. The map directly below shows the effect warmer temperatures might have on snowpack in Oregon. This could create problems for all users, including fish, dependent on summer streamflows*

Figure 13a: Current Precipitation Conditions

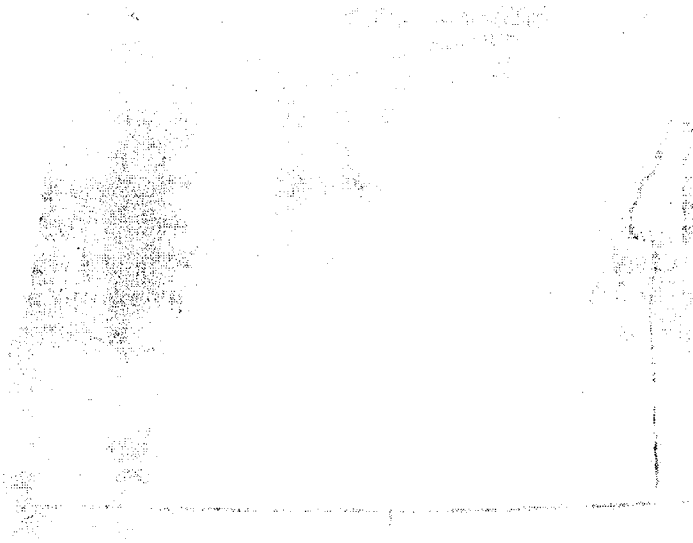
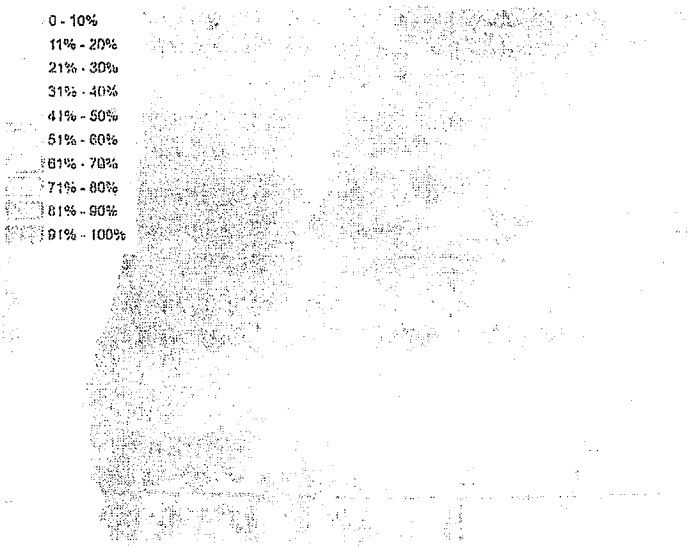


Figure 13b: Future Scenario (3 °Temp Increase)



The rainfall patterns under some of the Global Climate Model outputs indicate that rainfall, even if it increases, will come in a more concentrated period in the winter months (Dec-Feb). In addition, most models suggest decreases in the amount of summer precipitation. Most critically, for streamflow, regardless of the changes in seasonality of precipitation, runoff will almost certainly increase in winter and decrease in summer in any basin with a significant snowmelt component. This timing change will likely increase the need for natural and manufactured storage areas, and it will also likely increase the risk of incidences of extreme or peak flow events that cause flooding, erosion, and less capability to recharge groundwater aquifers in some parts of Oregon.

Increased Demand for Water. Climate change is expected to cause a larger and more complex wave of human migration. It is quite possible that Oregon will see a rise in population from "climate migrants." Naturally, population growth places a larger demand on water resources, and therefore, increases competition between uses and among users. Water demand for irrigation may also increase as transpiration increases and growing seasons are extended. Water users that depend on low elevation watersheds for water supply may find difficulty meeting future water needs, where a slight temperature rise can turn snow into rain. Roughly, just under half of Oregon's population depends on water from "snow-transient" basins (CLI, 2007).

Rising water temperatures and declining summer streamflows could seriously stress salmon and other coldwater species. Northwest salmon populations are already at historically low levels. Studies suggest that about a third of the current habitat for the Northwest's salmon and other coldwater fish will no longer be suitable by the end of this century because of climate change. Areas particularly at risk in Oregon are the southwest and southeast, and north central area along the Columbia River. Projected temperatures through 2040 suggest that the habitat for these species is likely to decrease dramatically. *Discuss other impacts on aquatic species?*

Sea-level rise along vulnerable coastlines will likely result in increased erosion and the loss of land. Climate change is expected to exacerbate many of the stresses and hazards facing the Oregon coastal zone. Rising sea-levels will increase the erosion of the coast and cause loss of beaches and significant coastal land areas. A number of populated areas and towns along the Oregon coast are also at potential risk. Sea level rise also will increase the impacts of severe storm events through both wind erosion and flooding. Rising sea level and increasing storm intensity will increasingly stress infrastructure facilities built under different engineering standards. For water resources, these include water treatment plants, diversion facilities, and wastewater plants. The intrusion of salt water to those facilities built close to the coast will be a factor as well as potentially to groundwater wells that are close to the coast. Climate change impacts along the coast will not be limited to sea-level rise. Increased wave heights during storm surges and increased frequency of intense storms are already occurring and are affecting Oregon's coastlines, developed areas, and estuaries. Sea level rise will serve to exacerbate those impacts.

Increased insect outbreaks, wildfires, and changing species composition in forests will pose challenges for ecosystems. Higher summer temperatures and earlier spring snowmelt are expected to increase the risk of forest fires by increasing summer moisture deficits; this pattern has been observed in recent decades. (McKenzie et al., 2004; Westerling et al., 2006; Littell et al. 2009.) The ability of vegetative species to adapt to changing conditions is slower than that for more adaptive and mobile animal species. Stress on vegetative patterns will present significant challenges and hazards for water management. Drought stress and higher temperatures will decrease tree growth in most low and mid elevation forests and will also increase the frequency and intensity of mountain pine beetle and other insect attacks, further increasing fire risk and reducing timber production, an important part of Oregon's economy. Tree growth at higher elevations will likely be enhanced owing to longer growing seasons, currently limited by snowfall.

Research and Technical Questions

"Actionable science" is necessary for successful future decision-making at the State and local levels. While significant research has been done on climate change both globally and within the United States, and specifically with the Pacific Northwest, there is still a significant lack of clarity on the specific impacts at the regional and local level. In order to gain more clarity from the Global Climate Modeling (GCM) downscaling process and regional modeling, improvements are needed within the models themselves, and further research is needed on the extreme events such as intensity of precipitation during short periods of time that present significant challenges to water resource managers. In Oregon, more research and studies are needed to project climate change impacts throughout the state using the best available science. We must also expect and plan for uncertainty and flexibility, as climate conditions will fall within a wide range of scenarios.

Water Management

The change in timing and availability of water as a result of climate change may affect whether or not water users are able to utilize their water rights for the amount allowed. Less water may mean that juniors users are more frequently regulated to meet the water needs of senior water right holders. Water rights that protect water instream for a certain amount and time period may be also be at risk from precipitation changes and decreased snowpack. An increase in regulation to meet senior rights, protect instream needs, and water quality could result. Water managers and users will need to look for ways to conserve water, reduce demand, and consider alternatives or new ways to meet needs in a changing climate.

Public Awareness and Education

The media has dominated the public's perception of climate change to the point that polarized positions remain about the cause and severity of climate change impacts. There are some generally accepted conclusions about climate change that need to be refined and more effectively communicated to stakeholders. The use of more relevant research to inform Pacific Northwest stakeholders could be incorporated into the dialogue on this issue. Outreach should emphasize the need to move forward on developing reasonable adaptation strategies now rather than waiting for "perfect science."

Objective Stakeholder Involvement

There is a strong need to achieve mutually beneficial solutions. This includes identifying potential climate change scenarios and solutions without having perfect information. It is important to stress to adapt to a future that may be quite a departure from the historic past. This state should strive to develop an adaptation strategy that will address the many challenges of climate change. Strategies can be developed and implemented that address multiple objectives simultaneously.

Climate Change Policy
Oregon Water Resources Commission
February 25, 2009

Be It Resolved by the Oregon Water Resources Commission:

That Oregon's long-term water resources strategy should anticipate the potential effects of Climate Change on Oregon's water resources. Such a long-term strategy should directly increase the likelihood of fully achieving the co-equal goals of the Commission and the Department by:

- relying on the best available scientific data and research;
- monitoring the continuing effects on the amount of available water and the changing water needs of humans and natural systems;
- collaborating and leveraging other resources with Federal, state, local, and private partners who are also pursuing climate change mitigation and adaptation policies;
- ensuring adaptation and resiliency for Oregon's water resources and the natural function of the watersheds in which they reside;
- engaging other natural resource agency expertise as appropriate to develop and ensure an integrated approach to managing the state's water resources; and
- developing a policy toolbox that includes water conservation, streamflow enhancement, demand reduction, and water supply development, including natural and environmentally appropriate constructed storage.

Due to a changing climate, the Water Resources Commission reserves the right to review and modify this policy at any time.

Conclusion

Building partnerships to address the issue of climate change will be vital if Oregon is to be successful in dealing with the risks of climate change. Oregon should position itself to take advantage of the increasing awareness of the risks of climate change and the resources that are now becoming available to address the issues. Specifically, Oregon should look at adopting strategies that will adapt to the risks of potential climate impacts without waiting for the perfect science.

The Water Resources Commission may opt to review and update its policy statement on climate change, adopted February 25, 2009, to include a climate change element in the Integrated Water Resources Strategy.

Sources

Climate Impacts Group. *The Washington Climate Change Impacts Assessment*. M. McGuire Elsner, J. Littell, and L. Whitely Binder (eds). Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Oceans, University of Washington. 2009.

Climate Impacts Group. *The Washington Climate Change Impacts Assessment, Chapter 6 - Impacts of Climate Change on Key Aspects of Freshwater Salmon Habitat in Washington State*. Nathan Mantua, Ingrid Tohver, and Alan Hamlet. University of Washington. 2009.

Climate Impacts Group. *Scenarios of Future Climate for the Pacific Northwest*. Authors Philip Mote, Eric Salathé, Valérie Dulière, and Emily Jump. University of Washington. March 2008. http://www.cses.washington.edu/db/pdf/moteetal2008scenarios628.pdf

The Climate Leadership Initiative, Institute for a Sustainable Environment and National Center for Conservation Science and Policy. *Preparing for Climate Change in the Upper Willamette River Basin of Western Oregon, Co-Beneficial Planning for Communities and Ecosystems*. Report prepared by Bob Doppelt, Roger Hamilton, Stacy Vynne, Cindy Deacon Williams, and Marni Koopman. University of Oregon. March 2009. http://climlead.uoregon.edu/publications/climate-preparedness

The Climate Leadership Initiative, Institute for Sustainable Environment. *Climate Change Preparedness of Oregon Municipal Water Providers in Snow Transient Basins*. Authors Bob Doppelt and Becca Bartleson. University of Oregon. November 2007. http://climlead.uoregon.edu/publications/climate-preparedness

Eaton, John G., and Robert M. Scheller. *Effects of Climate Warming on Fish Thermal Habitat in Streams of the United States*, American Society of Limnology and Oceanography. 41(5), 1996, 1109-1115.

Hamlet, Alan F. University of Washington, Department of Civil and Environmental Engineering. *Summary Report Describing the Preparation of Hydrologic Data Bases of Pacific Northwest HUC4 Watersheds Used to Identify Basin Hydrologic Type and Quantify Temperature Sensitivity*. Prepared for the University of Washington, The Climate Leadership Initiative, Institute for a Sustainable Environment. July 2007.

Lettenmaier, D. P., M. W. Wiley, A. H. Hamlet and R. Palmer. *Implications of 2005 climate change scenarios for Pacific Northwest hydrologic studies*. Report prepared for King County (Washington) by the Climate Impacts Group (Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle). October 2005. http://www.cses.washington.edu/db/pdf/kc05implic479.pdf

Oregon Global Warming Commission, Subcommittee on Fish, Wildlife, and Habitat Adaptation. *Preparing Oregon's Fish, Wildlife, and Habitats for Future Climate Change: A Guide for State Adaptation Efforts*. 2008. http://www.dfw.state.or.us/conservationstrategy/docs/preparing_oregons_fish_wildlife.pdf

Palmer, Richard, and Margaret Hahn. University of Washington, Dept. of Civil and Environmental Engineering. *The Impacts of Climate Change on Portland's Water Supply: An Investigation of Potential Hydrologic and Management Impacts on the Bull Run System*. Prepared for the Portland Water Bureau. January 2002. http://www.cses.washington.edu/db/pdf/palmerhahnportland111.pdf

Population Action International. *Climate Change, Migration, and Population Growth*. Policy and Issue Brief. July 2010. http://www.populationaction.org/Publications/Fact_Sheets/Climate_and_Migration/climatemigration.pdf

00003542

State of Oregon: The Governor's Climate Change Integration Group, *Final Report to the Governor: A Framework for Addressing Rapid Climate Change*. January 2008 http://www.oregon.gov/ENERGY/GBLWRM/docs/CCIGReport08Web.pdf?ga=t

Tague, Christina, San Diego State University and Gordon E. Grant, USDA Forest Service, Pacific Northwest Research Station. *A Geological Framework for Interpreting the Low-Flow Regimes of Cascade Streams, Willamette River Basin, Oregon.* WATER RESOURCES RESEARCH, Vol. 40. April 2004.

Oregon State University. *OSU, Partners to Launch NOAA Regional Climate Consortium.* Press Release. September 22, 2010. http://oregonstate.edu/ua/ncs/archives/2010/sep/osu-partners-receive-funding-noaa-launch-regional-climate-consortium

Oregon Water Resources Department. *Oregon Water Resource Department's Climate Change Policy*, adopted by the Water Resource Commission, Feb 25, 2009 Commission Meeting. Meeting Minutes: http://apps2.wrd.state.or.us/apps/misc/vault/vault.aspx?Type=WrdNotice&notice_item_id=366

United States Global Change Research Program, Climate Change Impacts in the Northwest. Homepage: http://www.globalchange.gov/

University of Oregon, Resource Innovations Institute for a Sustainable Environment. *The Economic Impacts of Climate Change in Oregon: A Preliminary Assessment.* October 2005

Glossary of Acronyms and Water-Related Terms

Acronym/Term	Description
ACRE-FOOT (AF)	One acre-foot is the volume of water that will cover one acre to a depth of one foot and is equivalent to 325,851 gallons.
AR	Artificial Recharge
ASR	Aquifer Storage and Recovery
BiOp	Biological Opinion
BMPs	Best Management Practices
Bureau	U.S. Bureau of Reclamation
CFS	The rate of water flow that will supply one cubic foot of water in one second. Equivalent to a flow rate of 7.48 gallons per second (448.8 gallons per minute or 646,272 gallons per day).
CORPS	U.S. Army Corps of Engineers
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DEQ	Oregon Department of Environmental Quality
DEQ	Department of Environmental Quality
DHS – DWP	Oregon Department of Human Services – Drinking Water Program
DLCD	Oregon Department of Land Conservation and Development
DOE	Oregon Department of Energy
DOGAMI	Oregon Department of Geology and Mineral Industries
DRC	Deschutes River Conservancy
DSL	Oregon Department of State Lands
DWA	Deschutes Water Alliance
EPA	U.S. Environmental Protection Agency
EQC	Environmental Quality Commission
ESA	Endangered Species Act
GWMA	Groundwater Management Area
IFA	Infrastructure Finance Authority
MGD	Million gallons Per Day
NOAA	National Oceanic Atmospheric Administration, U.S. Dept. of Commerce
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rule
OBDD	Oregon Business Development Department
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OHA	Oregon Health Authority
OPRD	Oregon Parks and Recreation Department
ORS	Oregon Revised Statute
OWEB	Oregon Watershed Enhancement Board
PUD	Public Utility District
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WRC	Water Resources Commission
WRD, OWRD	Oregon Water Resources Department

Placeholder: Appendices

Appendix 1: Management of Water Resources – Agency Appendix

Soon to Come!

This purpose of this section is to illustrate how state and federal natural resource agencies coordinate on water resource management in Oregon. An outline of each agency's mission, plans and programs will allow the public to access information all in one place.

Appendix 2: Data and Information Gaps

The following link directs you to a document that outlines data and information needed to manages Oregon's water resources. This document was prepared for the April 14, 2010 Policy Advisory Group meeting. Recommendations that were made by advisory members during that meeting are not currently reflected in the document. http://www1.wrd.state.or.us/pdfs/04_14_10_Presentation_Materials.pdf

Appendix 3: Key Studies and Plans

The Integrated Water Resources Strategy Agency Advisory Group, compiled a state-wide overview of major plans or strategies that drive economic development and natural resource management in the State of Oregon. This overview was prepared for the July 13, 2010 Policy Advisory Group Meeting. http://www1.wrd.state.or.us/pdfs/7_13_Presentation_Materials.pdf

Appendix 4: Funding Gaps

(Forthcoming – 2011)

Appendix 5: Education and Outreach Gaps

(Forthcoming – 2011)

RECEIVED

MAR 2 5 2011

UMATILLA COUNTY
PLANNING DEPARTMENT

March 21, 2011

Tom and Maureen Rugg
P.O. Box 209
Pilot Rock, Oregon 97868

Commissioner Bill Hansell
Umatilla County Board of Commissioners
Umatilla County Courthouse
216 S. E. Fourth St.
Pendleton, Oregon 97801

Commissioner Hansell;

We strongly support the planning commission's recommendation to the Board of Commissioners for 2 mile setbacks for wind turbines from rural homes in Umatilla County without a waiver. While we would like them to be much greater, preferably 5 miles or more, we realize this is probably not politically achievable. There is no doubt these developments lower adjacent property values and degrade living quality. To those of us forced to live by these developments, you are apparently our last voice left to mitigate some of the effects of these turbines and their subsequent transmission facilities upon our lives and property values.

As reference to the benefit to Oregon job growth from the subsidies given these developers, we would recommend articles in the 13th and 14th, 2011 editions of the Oregonian written by Ted Sickinger and Harry Esteve. Regarding the overall economy of wind generation, a good source of information is The Wind Farm Scam written by a British ecologist named John Etherington, available through Amazon Books. Dr. Etherington was commissioned by the country of Denmark to study their wind generation failures. He makes it clear that wind farms must be backed up to their total capacity by some other source of reliable generation such as hydro or natural gas to provide power for the 65 to 70% of the time they are not producing at their rated capacity, making their carbon sequestration negligible at best. When some of the sites recommended here have under 30% wind efficiency factors, it is apparent that developers are not looking at Umatilla County as a wind resource, but rather for the subsidies Oregon provides, and the backup power sources and transmission facilities already in place.

Pacific Power and Light is now asking Oregon's public utility commission to approve up to 15% rate increases a year to help mitigate costs for their wind developments in Wyoming , a state which has many sites with much more productive wind resources than Umatilla County.

Decommissioning is another aspect of this development that needs careful scrutiny. When the initial contracts are up and the useful life of these turbines has been reached, will the landowners be responsible for their removal if their continued use is not economically viable? Compliance of this needs to be made mandatory and enforceable.

Tom and Maureen Rugg

Tom Rugg
Maureen Rugg

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RECEIVED 30

MAR 21 2011

UMATILLA COUNTY
PLANNING DEPARTMENT

March 20, 2011

Umatilla County Board of Commissioners
Umatilla County Courthouse
216 SE Fourth Street
Pendleton, OR 97801

Honorable County Board of Commissioners:

This input is being respectfully submitted for inclusion as my comments on the **Proposal Umatilla County Development Code Amendments – Public Hearing held By the Board of Commissioners on March 17, 2011 and for the proposed meeting of May 12, 2011.** These comments relate to the version of the **Proposed Amendments To UCDC 152.615 and 616 HHH dated February 24, 2011.**

There has been a significant amount of time and effort invested by everyone associated with this issue; justifiably so, since it is a very important **Land Use Decision** that will impact all involved and all the **citizens of Umatilla County,** for many years to come.

The Windmill issue is important to **two basic groups**; those that stand **to gain** and those that stand **to lose**. The **gain group** consists of participating land owners and windmill companies. The risk to this group is minimal to nonexistent. The participating landowners in particular, risk nothing but, stand to gain significantly. The **lose group** is in a unique position. The possibility of a gain is near zero; the possibility of a loss is great. Specifically, we are talking about adverse living conditions, which adversely affect the landowner's quality of life and property values. The property owner "might" and I emphasize **"might",** receive some compensation for certain adverse impacts but, such arrangements will most likely be an attempt to compensate for "Loss" and only in rare cases would be recognized as a "Gain" for the landowner. This is the **major distinction** between the **two groups**.

The second group has much **to lose** and nothing **to gain.** It is understandable as to why this is a dividing and emotional issue. As the windmill projects expand, they encroach more and more into areas where this conflict exists – areas where this conflict of use will not decrease overtime, unless it is dealt with fairly and equitably. If this does not occur in the current process, then the conflict between the groups will expand and continue.

Therein lies the basic problem to be dealt with in resolving this issue and moving forward. I would like to emphasize that time is of the essence in completing this process, due to the fact that wind power development is moving forward quickly; because the decision to **"grandfather"** those applications are already in progress, unreasonable delay could render the pending decisions meaningless.

It is obvious from the process thus far, that the major issue between the two groups is **Setbacks** and how they affect adjacent and affected landowners. Input on this issue has varied widely from minimal to perhaps unreasonable requirements. Let us look closely as to the objective of "Setbacks"; what are they supposed to accomplish? They are to **Mitigate impacts** to the second group, while not unnecessarily impacting the first group. That is, legitimate impacts to the second group must be dealt with **adequately, fairly and equitably. Setback Requirements** must be realistic and mitigate the significant issues.

How best to determine **Setback Requirements**? If we are to strive for the most **credible solution**, then we must seek the most recent and credible information and data available; not a guess or an estimate. A decision based on that method will produce one that has been driven by emotion. This a **pivotal decision**. It must be based on a sound process. The **sole objective** is to mitigate **significant specific impacts**. To achieve this requirement, a great deal of time to research and find information that is **credible and supportable** on which to base this very important decision is required.

We are fortunate to have a Planning Commission that was prepared to do just that. They are to be commended for their efforts. There has been work done in various parts of the world on this subject and that information is available and is very useful. Mr. Reeder used data created by the **CH2mHill, an Engineering Contractor for Iberdrola Renewables, Inc.** , for the **Helix Wind Power Project**. This analysis **is the best and most pertinent data** and information available for the **Setback** issue.

If the analysis produced by Mr. Reeder and his committee is in dispute, then I would assume that the dispute is based on **data and information more credible than found in the Helix Project**. I am unaware that such data exists. Therefore, I would suggest that Mr. Reeder's analysis be used as the basis for your pending decision. **By doing so, your decision will be based on credible data and information** and not on arbitrary guesswork or estimates. After all, the objective of this entire process is to treat all parties with fairness and equity. Facts go along way in achieving that goal.

The Helix Wind Project Noise Report and Mr. Reeder's subsequent analysis brings with it another important variable in arriving at a decision for **Setback Requirements.** That is the issue of **Cumulative Effects. The Helix Project** is adjacent to and in close proximity to **older windmill projects that are in operation**. Cumulative Effects of the affected area **need to be considered.**

We have in the past, tended to process proposed projects on a **stand alone basis**. In the past that may have been appropriate. With the magnitude of windmill projects that are looming in the future, this is no longer the fact. An adjacent project or projects will definitely alter the impact and analysis picture. This might be new projects along side operating projects or expansion of existing operating projects. If you take this issue and apply it to the **Helix Project**, for example, and a rural residence is rated a 36dBA for a 1.5 MW generator and 40dBA for a 3.0 generator, will that **data hold true if existing windmills are considered?**

Taking the **Cumulative Effects** issue a step further, it would seem that a **Credible Noise Study** should be required to determine the base dBA levels if Cumulative Effects appear to be a critical issue. It also appears to indicate that the **assumed base level of 26dBA to be outdated and in need of rethinking and revision.** This needs to be taken into consideration to accurately assess impacts and establish **Setback Requirements.**

The "**Credible Noise Study"** could be used as a planning tool. A **Pre- project Noise Study** would establish base data, potential conflicts as well as being useful in **project monitoring.** This would only be required on projects where potential conflicts might exist; as we look ahead in the wind program that might well be most of the future projects. Therefore, the **Noise Study** would become an **important planning and monitoring tool** for dealing with the primary **Setback** issue – "**Noise".**

Mr. Reeder's analysis is the best tool available to establish **Setback Standards.** It needs to be used in conjunction with **Cumulative Effects** where appropriate. This would establish a **factual approach** to resolving this important issue, thus moving us away from a purely emotional driven process. This will go a long way toward **resolving project conflicts** in the **planning/design stage**, as opposed to the **operational stage**.

The goal of **Umatilla County** should not be "How many windmills **can be accommodated?**" Rather it should be our goal for "How many windmills **can we accommodate in a responsible resource manner?"**

Respectfully submitted,

Dave and Judy Price
80488 Zerba Road
Athena, OR 97813

UMATILLA COUNTY BOARD OF COMMISSIONERS
Meeting of Thursday, March 17, 2011
9:00 a.m., Room 114, County Courthouse, 216 SE 4th St
Pendleton, Oregon

** ** **

9. Clarify Conditional Use Reference in UCDC 152.060.
10. Parking Standards.
11. Boundary Line Adjustments – Date of Creation.
12. Boundary Line Adjustments – DEQ Site Suitability Approval
13. Mobile Homes Not to be used as Storage Units
14. Modify Conditional Use Permit Section.
15. Replacement Dwellings in the EFU Zone.
16. Type II Land Division - UCDC 152.684 (E) modified.
17. Cargo containers.

Commissioner Hansell asked about #7. Mr. Jennings explained that in the past the Planning Director had the option of granting an administrative decision for a variance in the industrial or commercial zones. The proposed change is to require a variance application, which would include public notice, just as with any other variance.

Mr. Jennings explained #17 on storage containers. They are becoming more popular and the county has no real permitting process. They aren't allowed currently because they don't meet the definition of a structure. So in this process they would first have to be defined and then adopt language for the permitting process.

Mr. Jennings read the proposed definition:
STORAGE CONTAINER: "A new or used prefabricated metal, wood, or composite type container, in excess of 120 square feet, manufactured for the transport of products and materials, used for the storage of agricultural, commercial, industrial, or residential products and materials, accessory to the principal building or use. These include piggyback containers that can be transported by mounting on a chassis or transported on a flatbed trailer (commonly referred to as freight, shipping or cargo containers), or truck trailers/van boxes that do not have a chassis or wheels. Such containers shall be totally enclosed."

Commissioner Hansell asked about the requirement to be accessory to the principal building or use. Mr. Jennings used the example of use in a rural residential zone where it would be accessory to the dwelling for personal storage. There does not necessarily need to be another building on the property if the container were used on farm zoned property however, because it could simply be accessory to the farm use. They would also be for personal use only; not rented out to others.

Commissioner Doherty noted that the county has had a lot of abandoned vehicles used for storage of solid waste and asked how the proposal would affect this. Mr. Jennings used the example of a bus. If there are wheels under it, it will not be permitted as a storage container. If it is not licensed it becomes solid waste. If licensed and operable it may be used, but not under the definition of a storage container.

Commissioner Doherty wanted to discuss item #13 and clarify that there was no proposed change to the current regulations regarding siting of mobile homes for residential purposes. Mr. Jennings confirmed that the amendment was related to conversion to a non

residential structure only. The proposal would permit conversion in the EFU and GF zones only, and would also require a farm exempt permit as well, for the conversion to farm use.

Commissioner Doherty gave a hypothetical situation of mobile homes on a property for farm labor. He wondered if there would be any restrictions on what could be stored if converted. Mr. Jennings explained that they could be converted only for storage of farm related materials. Commissioner Doherty asked if that intent was clear enough in the proposed language. Mr. Jennings replied that it does not specifically state that conversion is not for personal items. Ms. Mabbott added that it is much more clearly stated in the proposed language than it has been in the past, and a mobile home could not be brought in specifically for storage. It would have to have already been there for human occupancy, and then converted.

Mr. Jennings explained that replacing a home would require a zoning permit to approve the new home, and if the applicant wants to convert the old home they may do so at that time, but only in the EFU or GF zones. There would be no restrictions on the location of the new dwelling other than setbacks from property lines and flood hazard areas.

Commissioner Doherty asked about permits required by the state. Mr. Jennings explained that they would be required to obtain a farm exempt permit. If relocating the mobile home for storage, they might need a placement permit as well, but they are typically left in the same location.

Commissioner Doherty pointed out that the county spent 15 years trying to establish the principal that we don't want to junk up the county, and asked what the proposal would do to that. Mr. Jennings explained that it clarifies what our general policy has been; that manufactured homes are not allowed for storage in residential or commercial zones. But it also requires a farm exempt permit if converted for storage in the EFU or GF zones. He felt it would improve the situation by putting it in the ordinance, not just general policy. Commissioner Givens argued that it may clarify, but also puts more onus on the county to determine if it is actually being used for storage. County Counsel Doug Olsen noted that the proposed language actually gives the county more authority to deal with illegal use.

Ms. Mabbott commented that staff assumed that the board would want to allow some flexibility, but it could be written that in no zone are manufactured homes used for storage. Commissioner Doherty asked if the proposal was a request from county constituency. Ms. Mabbott replied that it was not, but there is currently nothing specific in the code and staff has been challenged. It was proposed to add clarity to the code.

Commissioner Doherty commented that if the purpose of zoning is to regulate to prohibit from diminishing the value of other property, then he was concerned that we could end up "junking up the neighborhood" with this proposal. It is possible that a person might not want to incur the expense of removing a mobile home and could get by it with this

permit. They could just let it sit there and do nothing with it. Staff agreed this was possible.

Commissioner Doherty asked if the Board was to act on all amendments separately or together. Mr. Olsen explained that the proposal was to approve amendments #1-16 together and leave #17 on its own. Commissioner Doherty replied that his preference would be to leave #17 out.

Mr. Jennings clarified that for item #13 the Board would rather not allow mobile homes for storage in any zone. The Board agreed. Mr. Olsen suggested deleting the exception in the last sentence.

Gary Rhinhart, Chairman of the Planning Commission noted that the Planning Commission had the same concerns about #13, but they also wanted to allow flexibility. If the Board had issues with it, he would urge them to just order the Planning Department to change the amendment.

Commissioner Hansell asked for comments on items #1-16 from the public. There were none.

Discussion and Deliberation; Items #1-16:
Commissioner Doherty moved to change proposed section #4 of Development Code section 152.013 to delete all language starting with "except in EFU or GF zones". Commissioner Givens seconded. Motion carried.

Commissioner Givens moved adoption of Ordinance #2011-02. Commissioner Doherty seconded. Commissioner Hansell stated for the record that this included items #1-16 of the presentation, with #13 as amended. Motion carried.

Discussion and Deliberation; Item #17:
Commissioner Doherty stated that it has been his experience that the outcome of good intentions does not always turn out as expected. He asked if "accessory to the principal building or use" allowed for residential use in the EFU zone as well. Ms. Mabbott replied that it did, but if there were no dwelling it would allow use associated with farming only.

Commissioner Doherty asked about standards to deal with issues like stacking. Mr. Jennings noted that criteria address that and require that, if used for anything other than storage, additional permitting would be necessary.

Commissioner Doherty asked if containers would be permitted in all zones and if the proposal was the request of the public. Mr. Jennings replied that the proposal would allow containers in any zone, but it was not the direct request of the public. Code Enforcement has dealt with the issue for many years and containers fell into a gap. The amendment would clarify. We need to have a process to allow them to be dealt with.

Planning staff has held work sessions with the Planning Commission and public, and this is what we came up with.

Ms. Mabbott explained that there is high demand to allow containers and the current code is silent. The proposal allows them with proper criteria and permits. There has been a lot of discussion from both sides and this proposal falls in the middle. Commissioner Doherty asked about setbacks and the number allowed. Ms. Mabbott explained that the setback would be the same as for any structure and the number is restricted by the buildable area, which is 75% lot coverage in a residential zone.

There was some discussion about restrictions related to aesthetics. Commissioner Doherty stated that he is just not comfortable with allowing containers. Ms. Mabbott noted that the alternative would be to not allow them at all, but staff has heard from a lot of public that want them because they are affordable, secure storage, and a lot of people feel very strongly about it.

Gary Rhinhart gave the Planning Commission's approach. They heard testimony that other counties are dealing with the same issue. Storage containers are more and more available, and people are more interested in using them, especially because they are very secure. A lot of discussion was had at Planning Commission about painting and the number, but those kinds of restrictions were removed because the issue was very split. What has been presented to the Board was felt to be the most workable solution. Commissioner Doherty asked that the issue be tabled for further discussion.

Commissioner Hansell stated they would defer to another Planning Commission meeting. Mr. Jennings asked if they wanted it to go to Planning Commission or the Board. Commissioner Doherty clarified that he would prefer it be addressed in a work session with the Board and staff. Commissioner Hansell added that it could be collaborative with the Planning Commission.

Commissioner Doherty moved to defer to item #17 to a work session. Commissioner Givens seconded. Motion carried unanimously. Commissioner Hansell noted he had not asked for public comments and asked if there were any. Ron Brown noted the importance of containers for chemical storage on farms. He would like to be invited for discussion at the work session. This was noted by staff.

NEW HEARING:

Update of Umatilla County Development Code, #T-10-039. Amendment to Conditional Use Section 152. 616 (HHH) of the Umatilla County Development Code, pertaining to standards for large scale commercial wind energy projects.

Commissioner Hansell called for abstentions, bias, conflict of interest, declaration of ex parte contact or objections to the jurisdiction of the Board of Commissioners. Commissioner Hansell noted that he had received phone calls and visited with people

who have asked for discussion. Their office had received correspondence as well. Commissioner Givens and Commissioner Doherty also noted ex parte contacts. Commissioner Doherty noted that because this was a legislative decision this was not improper. The commissioners were just putting it on record so it was clear that all commissioners have had contacts on all sides of the situation advocated.

Commissioner Doherty explained that they realize there are a lot if different opinions and implications involved, and they can't make everyone happy. What is in front of them is what the Planning Commission heard, but the Board had not read all the information yet. They have not made a decision at this point, so it is the job of the presenters to persuade them through factual, well presented comments related to their decision. He stressed that some types of advocacy would not be helpful.

Commissioner Hansell entertained a motion to add Exhibits #1-28 to record. Senior Planner Carol Johnson passed out new exhibits received since packets were sent to the Board. Bob Levy noted the packet he had submitted from Wendy Kellington. He had given Planning Director Tamra Mabbott the original full document, but the Board only had the pertinent summary parts. He wanted to be sure the entire packet was entered into the record.

Commissioner Doherty asked if all correspondence that had been sent directly to the Board office had been included in the materials for this hearing. Staff confirmed that it had. It was also confirmed that Sheldon Kirk's letters were included, as well as any other correspondence that had been submitted to the Planning Department. Ms. Mabbott had stepped out of the office and they would wait for her to return to confirm that she had Mr. Levy's full packet. All other materials received made up Exhibits #1-36.

Commissioner Givens moved to enter Exhibits #1-36 into the record. Commissioner Doherty seconded. Motion carried.

Recess:
Commissioner Hansell called for a 10 minute recess. The meeting was reconvened at 10:20 a.m.

Commissioner Hansell asked Ms. Mabbott about the exhibit from Mr. Levy. She confirmed receipt of the full packet.

Commissioner Givens moved to add the Levy materials in Ms. Mabbott's possession to the record as Exhibit #37. Commissioner Doherty seconded. Motion carried.

Planning Commissioner Clinton Reeder prepared to present the proposed changes to Conditional Use Section 152.616 (HHH). Commissioner Hansell asked Commissioner Reeder about the purpose of his editorial that had appeared in the East Oregonian the previous day. Commissioner Reeder explained that the intent was to clarify that the proposed 2 mile setback is not to completely eliminate towers in that 2 mile radius, but to give people a say in what happens to their property. He used the example of the Helix

Project, which only has ¼ mile setback from homes, which is non defensible, and the Energy Facility Siting Counsel (EFSC) says that they have no written justification for it.

One of the local EFSC representatives will be going early to their meeting next week to talk about taking a second look at their standards. Part of what is coming out of Umatilla County taking a closer look at setbacks is that it has lead to EFSC taking a second look at their setback standards as well.

His editorial was not intended to affect this meeting other than clarifying the proposed setback. Commissioner Hansell was concerned that it puts the Board in a corner if they don't agree, because if the Board chooses not to follow the Planning Commission's recommendation then it comes across that the Board is basically agreeing that they want to keep the rural residential citizens second class. It creates awkwardness.

Commissioner Reeder responded that, with all due respect, if it's awkward then it fits the situation, although it was not his intent. He understood the complication it posed for the Board, however. Hopefully his presentation would clarify. Commissioner Hansell added that there is a group that feels they have been disenfranchised through the hearing process, and he was concerned that Commissioner Reeder's editorial might further enhance that feeling.

Commissioner Doherty clarified for the public that EFSC stands for the state Energy Facility Siting Council. They have their own standards for projects that go to them, and the county has another set of standards for projects that come to us (under 105 MW). County Counsel Doug Olsen added that EFSC projects are reviewed by the county for comments, and our suggestions may be applied. EFSC has that discretion.

Due to computer complications Commissioner Reeder's presentation was distributed in hard copy. Commissioner Reeder explained that his editorial was written to make the statement that the 2 mile setback would give people within that setback the right to say no. At 2 miles, the person living in the rural area would be given the opportunity to discuss with the wind company how close a turbine may be located, and where. The conflict that has arisen from tower placement is destructive to the community. He referred to a quote about the accumulation of wealth and decay of man, and noted that that is exactly what we have going on in Umatilla County. The Planning Commission has tried to address both sides of the issue in a way that makes sense for the community, not necessarily limiting wind development, but makes sure that everyone within a project boundary is treated fairly.

To point out that he and the Planning Commission had not been arbitrary or capricious, Commissioner Reeder referred to books on forensics relative to wind tower development, and sleep deprivation and interruption.

Commissioner Reeder began his presentation by explaining that the problem comes down to economics versus the neighbors to the towers, who are being traded inappropriately. There are 40 homes affected within the 2 mile radius proposed for the project around

Helix. That is 30% of the Helix community being affected by one project. It is time to take a closer look.

Commissioner Reeder pointed out that he is a professional economist. Investors can sell projects, and part of the game in finance today is to package an investment so it is sellable, which means to have certainty as to structure and fixed cash flow that is also highly certain.

One problem with big corporations coming into a small community is that we don't know who we'll be dealing with tomorrow. Close neighbors to the projects become "victims" in the process because they are last on the list of concern. Investors, creditors, executives, contractors, and tower site owners participate voluntarily in the process. Emergency service providers, cities, and rural communities have some choices and have limited negotiation, but neighbors to the towers have little protection from project participation, with the highest imposed effects.

Commissioner Reeder noted stress induced effects of wind towers, particularly sleep deprivation. People are starting to buy their own instruments to measure noise impacts. He referred to a proposal from a wind power consultant that we need to study the effects more closely. There are enough towers up to do it now.

Commissioner Reeder moved on to public utility economics and regulatory philosophy. He explained the public utility economics theory using the example of garbage service, where a community didn't want multiple providers fighting over control. A model of providers was created with one or two providers with some community control over routes and fees. The problem with wind is that it has not been located in controlled sites. Towers are being distributed throughout the EFU/GF zones and there are conflicts between what's allowed industrially, and what's protected in terms of lifestyle, etc.

Part of what wind power is doing is challenging the concept of public utility regulation. The effect is what we're seeing between EFSC and the county on standards. It is a public utility issue relative to who should regulate wind power and public utilities. The current rules require that the state and county work together.

Commissioner Reeder noted the list of indirect effects of sleep disruption. Obesity is on the list because research has discovered that body chemistry changes with sleep deprivation, causing cravings for carbohydrates.

Commissioner Reeder went over the extent of the impact of the project at Helix. He came up with 134 homes based on residential listings in the Helix phone directory. About 1/3 of that community is affected by the wind project. He referred to the Noise Map (Figure 1). A gray line circles the project on that map, which is the noise boundary for 1.5 MW towers. He then referred to the second Noise Map (Figure 2) which indicates the boundary for 3 MW towers. In general, going from 1.5 MW to 3 MW moves the boundary out about ½ mile on the down wind side.

The next information sheet included numbers taken from Commissioner Reeder's measurements, which involved taking the distance from a home to the tower on multiple sites, calculating how far back from the tower the house would have to be to protect it. The average on the west side of the project is 1 mile. For the 3 MW towers it is 1.5 miles. 2 miles is within the ballpark. On the east (down wind) side the average is 1.2 for the small towers and 1.8 miles for the large towers. The difference between up and down wind is half a mile. Commissioner Hansell asked what was being measured, and what standard was being use. Commissioner Reeder replied that the noise map projects the boundary of 36 decibels. The map also shows where the 50 decibel circle is around each tower and the 36 decibel boundary. Commissioner Hansell requested color copies of Commissioner Reeder's maps for all in the room.

Commissioner Reeder discussed up wind versus down wind measurements he found when measuring. Bigger towers cause the boundary of noise protection to move out farther. There is a mile difference between minimal and maximum protection distances. As a community, the Planning Commission has tried to come up with a setback that will allow everyone to be party and protect their interest.

Commissioner Reeder explained his drawing depicting how a property owner might use a noise easement to protect their view in one direction, but be willing to have them anywhere else outside one mile. A neighbor might do something differently. This is the market at work; all parties sitting down and negotiating. The Helix EFSC report states it meets the standards if all conditions are met; meaning 28 noise easements are signed. If not then they must change the tower locations so that no house is within the boundary that has not signed an easement.

The next topic was "How much is my protected territory worth?" Commissioner Reeder explained that a two mile radius from a dwelling protects approximately 8,000 acres. This might seem like a lot, but the acreage protected dramatically decreases as the setback decreases. An easement allows people to decide. The community would benefit from coming up with a solution that people can voluntarily agree to, which protects the interest of all and allows towers to be built.

Commissioner Reeder stated he has grandson with autism and health problems. Noise frightens and panics him and Commissioner Reeder has seen first hand how wind towers can impact families like this.

Commissioner Reeder has spent most of his life in conflict situations and has been recognized nationally for that. He spent four months working with the Department of Agriculture (ODA) introducing the Agriculture Water Quality Management Program. NOAA Fisheries was introducing their program at the same time, which was draconian and people were uncertain whether NOAA or the State were giving the speech. ODA asked that he attend the meetings, at many of which people were armed, and sometimes so emotional they could not speak. Commissioner Reeder stated that threats are not admissible evidence as testimony in these hearings, noting that he had received a couple of threats from wind companies. He also noted he had put together a 30 page response on

behalf of the Planning Commission and anyone who would like to endorse it, addressing all comments received from wind companies since October of 2010, which illness had prevented him from completing prior to this meeting.

A member of the audience noted that the wind blows sound from towers on the ridgelines across the canyon. Heat rises, raising the sound at night, and dropping it at night when it cools. Commissioner Reeder replied that one of the power companies has suggested we deal with Vansycle Canyon and north Helix area completely separately from the Blue Mountain face, and consider treating south Pilot Rock similar to the way towers were first sited in Umatilla County. The companies themselves would prefer to think about zoning the county in terms of standards. One proposal is to zone the county so that there is a wind ordinance with sub areas with different standards. Part of his role in this is to identify the problem areas within the county and who the players are, to help come up with a set of standards that are county-wide and deal effectively with similar problems in different zones. He would like to think there is a solution that would make everyone happy, and the Planning Commission was convinced it was time to do something different.

Commissioner Doherty thanked Commissioner Reeder for his work. He asked if the Planning Commission was hearing objections focused just on setbacks and noise, or was the view shed still an issue. Commissioner Reeder replied that setbacks were their primary concern. It was primarily landowners at the last hearing, concerned about the setbacks. There was not much testimony from wind developers. But the Planning Commission is not ignoring any party, and they have tried to integrate all testimony at hearings over the past two years. Commissioner Doherty asked if wind developers are participating less because they feel their concerns were addressed. Commissioner Reeder replied that they have sent material in writing, but the Planning Commission was not where the decision would be made, so they would be more interested in the Board meeting. He noted that he would indicate to the Board which standards the wind developers objected to while reviewing the proposed ordinance.

Commissioner Doherty noted that it has been his experience that there tends to be a feeling that if an opinion is expressed and it wasn't agreed with, then one hasn't been heard, but that just isn't true. We have to make judgment calls and just because we come down on a different side of something doesn't mean that others haven't been considered or listened to. Commissioner Reeder reiterated that there is no one who has been before the Planning Commission who hasn't been listened to. The two mile recommendation from the Planning Commission was unanimous and it wasn't just spur of the moment. They have been building towards it through a public work session and two years of public hearings. Ms. Mabbott pointed out that there were two other members of the Planning Commission present in the audience if the Board wished to corroborate what Commissioner Reeder was saying.

Commissioner Hansell asked Commissioner Reeder to explain the color copy of his noise map and what the lines meant. Commissioner Reeder explained that the orange line was the noise boundary and the yellow line around the towers was the 50 decibel boundary.

He went to multiple locations and measured from the 36 decibel line in to come up with the numbers in his presentation.

Commissioner Reeder pointed out that there are three houses on the noise contour map that are within the 36 decibel area. A noise easement will have to be signed or the site boundary would have to be changed so that the houses are outside. The green line represents the leased ground for development in the future. There are also three homes missing from the map, belonging to Brett Leake and Wade Muller. There are 29 homes within the noise boundary of the Figure 2 map.

Commissioner Givens asked Commissioner Reeder if he considered ambient temperatures, wind conditions, etc. Commissioner Reeder explained that he did not put together the noise contour maps. They were part of the materials submitted to EFSC by Iberdrola when they applied to amend the original site certificate. It shows the original project and their amendment application. It is currently up for EFSC review, with one formal challenge filed by Mr. Muller. If the developer doesn't get noise easements signed by property owners, they have to adjust their project.

Commissioner Reeder explained that if there were a 2 mile setback, the project on the map would not be able to happen. If people want the money from the development the community needs to make a decision together. Right now, neighbors are very unhappy, and tired of being ignored and not included in the development. We're trying to figure out how to make them players without killing the project.

He measured from the boundary in to the towers and calculated what the setback would have to be for the house to be outside. He came up with 1-1 ½ mile on one side and almost 2 miles on the other side. Commissioner Hansell asked Commissioner Reeder what he was measuring. Commissioner Reeder replied he used decibels and distance based on state standards of 36 decibels. It had nothing to do with the proposed ordinance. He explained the map they are all looking at was created by Iberdrola for their application to EFSC. Any house within the orange boundary will have to sign an easement to say that towers can be place closer. Noise easements as high as $150,000 are being offered right now.

Commissioner Hansell asked about the houses mentioned earlier. There is a quarter mile setback standard in the EFSC report currently, and all 28 houses on the noise contour map are inside the noise boundary. If a property owner within that quarter mile boundary doesn't sign a noise easement, the developer must re-configure the project. Today's decision will not affect the Iberdrola application with EFSC right now. Ms. Mabbott clarified that the quarter mile setback is one standard and compliance with the state noise standard is another, so what the map reflects is that, in effect, the setback is much greater than quarter mile in order to meet the noise standard. Commissioner Doherty asked if the county adopts a more restrictive standard, then it's discretionary with EFSC to apply the quarter mile standard. Ms. Mabbott added that it would be in their findings to decide not to use local standards.

Commissioner Reeder explained that the Planning Commission wanted to set standards to protect their citizens, and if EFSC decides not to use them, that's there decision. Ms. Mabbott clarified that the quarter mile is not in administrative rule or state statute, it's a policy. Commissioner Reeder stated that complaints started coming in when the developers started using bigger towers, changing the dynamics of the projects and how they impact the local population. EFSC needs to re-evaluate their standards based on the increased size of towers being used now.

Commissioner Reeder reviewed some of the changes in the proposed ordinance:

One addition to 152.616 was (2) Pre-application Meeting. It is written the way it is because it applies predominantly to tower installations that are smaller than 105 MW. The county has been holding pre-application meetings all along, but it has been informal. As projects have grown and the issues become more complicated, this has been formalized. There are two reasons for the pre-application meeting. First is to let people new to tower development and the process know the rules in this county. Second, it allows staff to make sure that all appropriate agencies and representatives are involved and they are acquainted with the developer. Power companies want to be excluded from this and do not want this to be a requirement if sited by EFSC. The Planning Commission feels that since EFSC will have to consider the county's standards it would be helpful for the developers to be familiar with the people involved from the beginning. Adoption would standardize. It would not expressly exclude the requirement, but if EFSC sited, one of the proposals would be to add a sentence that says that if the project is EFSC sited, it would not apply to that applicant.

152.616 (HHH) (5) (C) was rewritten. Wind developers are objecting to asking for nonproprietary wind data, but the county would like evidence that they have used a credible process to get their data. The proposed language under (1) is very specific that we are requesting "Nonproprietary evidence of wind monitoring data…", in other words, are you using a standard protocol that gives the county assurance that the developer is using technically competent people?

(2) Evidence of active utility transmission interconnects. Power companies would prefer to not have this language because in the early stages of the application process they're not really worrying about this yet. The county previously had a situation where we were pushed to issue a permit to begin construction when there were no easements yet in place for transmission. The county held up the permit until there was evidence of credible progress being made to establish a workable line route for marketing the power. Basically, the Planning Commission is saying, we don't want a bunch of towers with no place to market the power.

(3) Route and plan for transmission facilities connecting the project to the grid. This is a real issue right now because the grid is overloaded. There are certain times of the year when it isn't really a good market for all the wind power being generated.

The Planning Commission is trying to make sure the project is going to be developed whole, the power sold, and the project has a rational transmission line route. For the most part it is not a problem to developers, except for (2) because it is premature for some of them to do that at that stage of the application. Planning has been informal about that process if the project is EFSC sited.

Page 3: (D). These changes have to do with who you look at potential conflicts with; EFU, GF and forest uses. Previously the language said "including other wind power generation facilities." There was a situation which resulted in a lawsuit between two power companies having to do with who had the priority date. The Planning Commission would prefer to keep the language "including other wind companies", but the power companies acknowledge that this is something that needs to be resolved, without the county's intervention. At this point the Planning Commission is willing to remove that section and not speak to the issue of dealing with other wind companies.

(F) Vegetation. Commissioner Reeder and Ms. Mabbott had spent quite a bit of time with the Oregon Department of Agriculture, which administers the Oregon Agricultural Water Quality Management Program, covering all of rural Oregon. The Soil and Water Conservation District is the local management agency designated under that program to work with complaints about silt and erosion. The Walla Walla Watershed has been very outspoken and spent millions of dollars to enhance the Walla Walla watershed, and they do not want silt off the ridges in the Walla Walla River.

One of the issues the power companies should be aware of is that most land owners aren't aware of the liability for erosion, and the power companies and landowners must resolve how they are going to deal with that on and around the wind power sites. Will it be the landowner or the power company that manages the sites themselves? The NPDES Permit from the Department of Environmental Quality (DEQ) will not satisfy that issue. It is only good through the construction period, and they do not monitor after construction is over.

If there are complaints after construction they are sent to the Department of Agriculture. The Soil and Water Conservation District and/or someone from the Oregon Ag Water Quality Management Program will then pay a visit. That program is "warn and inform" first, but ends with very significant penalties. Almost no complaints, however, have gone to a civil penalty. They are usually resolved by identifying the problem, working with the landowner, and providing technical assistance. Ultimately, you can't escape working with these listed agencies, whether or not they are listed in the standards. The Planning Commission chose to go ahead and name them in the amendment. Landowners and power companies are going to have to decide who will hold the liability and how it will be determined. Right now, under the statutes, the landowner ultimately is liable. Commissioner Hansell asked if any complaints have been filed since the first project in 1997. There were none to Commissioner Reeder's knowledge.

Commissioner Doherty noted that the language is that the plan has to be developed in "consultation" with these agencies. He wanted to be specific about what we mean by

that; do they all have to agree on all components of the plan, and if there isn't concurrence, who says whether or not the plan is good enough to move forward? Ms. Mabbott and Commissioner Reeder replied that all agencies do not have to agree, and it is the Planning Commission who ultimately decides if the plan is adequate. From an agency standpoint, during construction, if they have an NPDES permit, DEQ will be the predominant party, unless it involves the farm land around the site. Then the Department of Ag will step in and advise.

Commissioner Doherty commented that his impression was that these plans are required to be done upfront in the process, which is a different way of approaching the consultations with agencies, because they are usually subsequent. Commissioner Reeder clarified that this language is not requiring approval from the agencies, just that the developer show who they consulted with and what about. Then if an issue comes up it can be dealt with. The power companies would be making a mistake to wait until they're operational to deal with the water quality, because during the construction phase, either ODA or DEQ could intervene and shut things down.

As they move up onto the ridges there are different soils and situation. Commissioner Reeder talked about a discussion he had with a farmer who farms successfully on the ridge lines. He doesn't have problems with water, but is using a one pass farming system, and has noted that he has at least twice the hawks on his property. That raises a red flag for putting wind towers in these areas because if the solution to the erosion problem is farming practices that bring in more hawks then there is a conflict between wind power development and farming practices that protect the waterways. Ultimately, we're talking about the effects locally of the Clean Water Act, the Safe Drinking Water Act, and the Endangered Species Act, all coming together on each of the watersheds and being tied to wind power development.

Commissioner Doherty asked if there were any variances built into the process. Commissioner Reeder replied that flexibility has always been built into this process, and the siting process is evolving with the size of towers and projects. Commissioner Doherty asked if something explicit needed to be added to the ordinance that provides for flexibility in the administration, and to address public concerns about bias. There was discussion about the word "consultation" being used in the ordinance and the role of the agencies relative to the water quality issue. Commissioner Reeder pointed out that the word "consultation" was carefully chosen because in most cases you wouldn't be able to get all the agencies to completely agree. What we want is credible technology used to protect the water, and the ability to see that the developer has done their homework.

Commissioner Hansell commented that there were at least three rules on page 3, for which Commissioner Reeder had stated that we wouldn't worry too much about it if they weren't followed, such as the pre-application meeting. He was concerned about creating an ordinance knowing that staff might be too flexible. Commissioner Reeder clarified that if the county sites the project the developer will be required to hold a pre-application meeting. If the project is sited by EFSC, the county cannot require it. EFSC can basically ignore our process requirements. Commissioner Givens commented that is why

they wanted the Energy Generation Area (EGA) removed, so the county would be able to process the applications locally.

(G) Fish, wildlife and avian and monitoring plan. The language removed relating to EFSC requirements can be added back in if the Board would prefer, but the Planning Commission had suggested taking it out. Commissioner Hansell noted the addition of fish and wildlife. Commissioner Reeder explained that those additions are tied to (F) because the vegetation and erosion issue affects fish and wildlife. All waters in the state are subject to drinking water standards, Clean Water Act standards and ag water quality. You can leave fish and wildlife out, but in fact, that issue cannot be escaped because the Endangered Species Act is a primary issue that must be addressed.

Commissioner Doherty noted that there was nothing specific in the proposal about the role of the technical oversight committee that goes along with the fish, wildlife and avian monitoring plan. He did not want that to become an issue that could halt a project. Commissioner Reeder replied that a couple of power companies would like to see that be struck from the proposal, but another wants it kept in because it gives them a good chance to get acquainted with the agencies and landowners in the area. We require pre-construction and post-monitoring so there is a baseline to look at. EFSC may or may not.

Commissioner Doherty asked if there shouldn't be a way to exempt smaller projects from this requirement. Commissioner Reeder replied that the avian issue with wind towers is huge internationally. Criteria started out addressing avian because that was the issue at the time, and one of the problems was electrocution. The aerodynamic of towers and transmission lines are being designed to prohibit nesting and perching sites for birds to eliminate this problem. Commissioner Doherty asked for language that states, "staff MAY require" these reports so that smaller projects don't have to meet this requirement. Commissioner Reeder commented that, at first, we were not certain of the affect of wind power on birds in the county. Bats have ended up being one of the bigger issues and we didn't even know we had a bat problem in the county. Not much is known yet about the cumulative effect of the towers on the area, and if criteria are made too flexible, then staff will spend all their time negotiating which standards the developer has to meet.

There was discussion on how to word this requirement without giving an outright opportunity to negotiate every part. Commissioner Doherty suggested it be part of the pre-application meeting to determine whether or not it's required. Commissioner Reeder felt that "shall" should be used with the understanding that the county would be flexible in the administration of it. Commissioner Givens agreed that "shall" should be used to avoid companies looking for loopholes. Commissioner Reeder noted that for every complaint of being too stringent on regulations, they are more apt to get multiple complaints because we aren't stringent enough. The language is a balancing act between the need for certainty and the need for flexibility.

A guest added for the record that the Walla Walla Watershed Council never gets involved in lawsuits or legal activity. They are an advisory group, not an environmental watchdog.

Recess:
Commissioner Hansell called for a one hour lunch break. The meeting was reconvened at 1:17 p.m.

Approval of Minutes:
Commissioner Doherty moved to approve the minutes of August 3, 2010 and August 16, 2010. Commissioner Givens seconded. Motion carried.

Continuation of hearing:
Commissioner Reeder passed out a letter from Chrissy Froese. Commissioner Doherty moved to accept it to the record as Exhibit #39. Commissioner Givens seconded. Motion carried.

Commissioner Hansell called for the color maps that were handed out to be added as Exhibit #40. Commissioner Doherty moved. Commissioner Givens seconded. Motion carried.

Commissioner Reeder reminded everyone that the proposed amendment was not his product, but that of the Planning Commission as a whole. The chairman, Gary Rhinhart was present, as well as David Lynde who is also on the Commission.

Commissioner Reeder continued explaining the proposed changes, beginning with (H) on page 3:

(H) Emergency Management Plan. This was basically just some language editing. He suggested that if the hearing is continued, this section be rethought, as some of the language could be consolidated.

(H) (1). Commissioner Reeder explained that with the wind towers, emergency service is a bigger issue than what has been addressed previously. Wind towers involve a lot of emergency services that the county responders are not set up to do, so wind companies contract with someone who can. The added language is intended to make it clear that high rise rescues are the responsibility of the wind companies and local emergency services will meet at the ground to provide their normal services. The Planning Commission is trying to get emergency services provisions tied together so there is a cohesive response process.

(2) Spill prevention. Some wind companies are suggesting that the SPCC permit will take care of this requirement, but the Planning Commission does not agree, especially if the SPCC permit is during the operating phase. The Planning Commission is suggesting that companies address spills prior to when a SPCC permit might be issued, which would be protective to a developer.

(3) Operations and maintenance plan. This involves work force and local response capability, so there is some overlap in the language that might be looked at. It also includes controlled access, so there is a gating issue with service roads. Developers

would prefer not to have to remap if a road changes within the boundary of a permit, but we need know for communications with emergency services, and to be able to bypass the scab ground and drainage. GPS road locations can be added to county maps to keep track of roads for emergency services.

(4) Emergency Response Plan. This relates to natural or man made emergencies or disasters.

(K) (1). Wetlands and streams. Commissioner Reeder explained that in the dryland country we have in Umatilla County, every place that carries water during snow runoff is an intermittent stream. Developers have to understand that their erosion control responsibility includes intermittent streams that don't run very often.

(5) Open space, scenic, historic, cultural and archeological resources. Commissioner Reeder explained that we have a new letter from the Tribes, which part of this language was taken from, to ensure that the proper authorities are notified of discovery of a historic site.

(L) Dismantling, decommissioning and rehabilitation plan. Commissioner Reeder suggested using the word "restoration" instead of "rehabilitation". There is a small issue with EFSC because our standards for restoration are pretty specific, but their standard is just to return it to useful condition.

Page 4. (6) Standards/Criteria of Approval. Commissioner Reeder explained that these are the standards that EFSC will look at and compare. If EFSC sited they will look at and consider using these standards. The Planning Commission feels that it is important that what we think the standards should be are addressed here, and EFSC has the authority to agree or disagree.

(A) Setbacks. (1) Tower to UGB. The original language protected the residential city zones with a 3,520 foot setback. This was not from the actual residence, but from areas zoned residential, so it basically is from city limits. Cities want it to be from the urban growth boundary (UGB) because they want to protect their expansion area as well. The new language reads that the setback from the tower to the UGB will be 2 miles or 20 times the overall tower to blade tip height, whichever is greater. That is an attempt by the Planning Commission to take into account the tower height issue, and we might have to look at that again, because on the same tower height there could be a larger generator, which may or may not change the noise level. Commissioner Hansell asked about the tower to blade tip height. Commissioner Reeder explained that it is measured from the bottom of the tower to the highest tip point. The newer towers are about 490 feet.

(2) Lands zoned UC. The primary feedback on this proposal questions why the setback for this zone is different. Why not just keep the setback at 2 miles from houses regardless of zoning? The proposal is to stick with 10 times tower height because most of the UC areas are pretty well developed with housing and it is not likely that towers will be placed in the middle of these areas.

(3) Tower to rural home. This is the same as from the city UGB; 2 miles or 20 times tower height. The 20 times the blade height has to do with size because as towers increase in size, complaints also increase, although we don't know how much of that is really because of noise or if it's visual. The Planning Commission suggests that the Board may want to investigate towers and setbacks in relation to technology now that there is a cumulative base to look at.

(4) Tower to boundary of right-of-way of county roads. This is two times the overall tower to blade tip height. EFSC is using 110% of the height, but the Planning Commission is not sure this is great enough to protect from debris. They've looked at distraction, ice throw, and collapse.

(5) Tower to boundary right-of-way of state or interstate highways. We might need one additional blade height to allow for easier cleanup of the site.

(6) Tower to archaeological and cultural sites. Developers want this worded so that this setback is determined on a case by case basis. EFSC recommends a 30 meter "no activity" zone around the site, which is less than our proposal. The Planning Commission might not object to case by case.

(7) Transmission lines. EFSC standard is 200 feet, and we are proposing 500 feet to empower the person who doesn't want the line right in front of their window. If the line is in a road right-of-way then it is within a corridor. The problem with right-of-ways is whether or not to handle them on a first come, first served basis; how do we protect the right-of-ways for public utility transmission for the long term. Commissioner Hansell asked about if a company has an easement right-of-way apart from the road right-of-way. Commissioner Reeder cited the example where the county required a company to indicate their preferred routes and good evidence that they were working with landowners to acquire easements.

(8) Design and operate within the limits of the noise standard. The wind power companies are held accountable for the state 36 decibel noise standard.

(B) Reasonable efforts shall be made to blend the wind turbine/tower with the natural surrounding area.

(C) Development and operation will protect wildlife, habitat, etc. This may require mitigation and/or submission of an annual monitoring report.

(E) Establishment and control of access roads. For emergency services the preference is to have roads named or identified by number and map. There is also language suggesting gates, but they are not required to be locked because it would be inconvenient for farmers and service people. This leaves some unresolved concerns, however, because there could potentially be problems with vandalism.

(J) Roads. (1) County Roads. This requires a Road Use Agreement with the county regarding impacts and mitigations as a condition of approval.

(2) Project roads. Suggests an engineered road design.

(L) Plan for dismantling and decommissioning.

(M) Surety bond. EFSC requires "financial assurance" and accepts letters of credit. However, financial assurance is not a financial guarantee. A surety bond is a guarantee of performance. We won't give on this because we don't want the county or the landowner to be responsible for the clean up bill, and we would prefer not to defer to EFSC.

Commissioner Doherty was concerned that this would require the county to take on an affirmative duty to clean up if a project defaults. In his experience the county has never had enough money from these pre-plans to actually complete a clean up project. He asked how developers felt about it. Commissioner Reeder explained that developers want the EFSC language because it allows them to not buy a bond, which is more costly then a letter of credit. A bond is more protective because if the index changes by more than 10% the bond has to be upgraded. Also, an annual bond review can be required, and there is a formula for upgrading the data in a bond statement.

Commissioner Doherty asked why the burden of clean up is not placed on the property owner. Commissioner Reeder replied that the Planning Commission feels that it is. Bonds used to say that they were payable to the landowner and the county, but the problem with that is, if there were a bankruptcy situation and the landowner's lease with the company transfers liability to the company, which no longer exists in bankruptcy, there is a legal question of whether it fall back to landowner. Commissioner Doherty commented that the one with the proprietary interest in the project would be the one ultimately responsible for decommissioning.

Commissioner Reeder noted another issue that came up is that one of the landowners with towers on the Helix project has in their lease a requirement that the power company provide a bond to protect the landowner from the same thing. In this case the project is double bonded. Commissioner Doherty requested there be further consideration on this issue. Commissioner Reeder agreed and noted that if the leases involved bonds to protect the landowners and we assume that it is the landowner's responsibility, we could probably do away with the bond. Otherwise, a bond requirement could still protect the county in case both the company and landowner are bankrupt.

Commissioner Reeder noted that the biggest concern from the public is ending up with abandoned wind towers. The bond gives the assurance that we can work with the landowner or other parties to make sure that doesn't happen. The real threat is bankruptcy. For example, the parent company for the Helix project is Iberdrola. The site certificate and assets of the development will transfer to Helix Wind Power Facilities LLC. Iberdrola is putting the project together and shifting the assets to a wholly owned

subordinate. If that subordinate goes bankrupt it leaves responsibility hanging because the liability is tied to the LLC.

(N) Tower coordinates. Requires the facilities to provide a GPS map so the county can transfer to our maps.

(7) Dismantling/Decommissioning. (B) Describes how to keep the bond current. Commissioner Reeder noted that (8)(A) on page 8 talks about the index used to update the bond requirement. The bond is to be kept current at least every 3 years, and if the index is tied to changes of more than 10% it would need to be updated at that time.

(7)(C) Restoration of site. Commissioner Reeder explained that there has been a lot of discussion about whether (6) should come first in this list or last because it states that roads and other improvements may stay if a landowner submits in writing that they will be responsible for them.

(8) Decommissioning fund. (A) This explains the calculations for updating the bond, as Commissioner Reeder mentioned earlier. Commissioner Hansell noted that the cost of decommissioning is not going to go down. If it's tied to an index that is going down, we may end up with a gap. Commissioner Reeder agreed, but noted that the value of scrap metal could make the towers valuable as well.

Stricken (F) This section was removed because it is no longer applicable. The bond is now payable just to the county, so there is no need for an arbitration provision.

Stricken (D)(G) This provision was removed because it deferred to EFSC, and the Planning Commission is unwilling to defer relative to the bond.

(9) Annual reporting. (H) This addition requires a summary of erosion control activities and its effectiveness. Commissioner Doherty noted that the burden of keeping bond information is on the project, and they will provide the information needed in the annual report to county. He was concerned about the additional responsibility on the county and the Planning Department staff to maintain annual reviews. There was discussion about public service costs and creation of new need.

(I)(2) The annual report requirement may be modified by the county as warranted. Commissioner Reeder noted that generally we don't reduce reporting requirements, because they are not onerous and the Planning Commission likes to be able to ask questions.

(10)(B)(1) Requires amendment to the conditional use for changes to access roads. This allows the county to keep maps current for emergency services.

This concluded Commissioner Reeder's report.

Planning Commission member David Lynde commented that the Planning Commission tried to get ahead of game, especially relative to fish. As far as the bond, he has not yet talked to a citizen who does not want the bond requirement.

Public Testimony:

Richard Jolly. 54462 Upper Dry Creek Rd, Weston, OR. Mr. Jolly noted that the county standards have been in place for a long time without review. In the mean time, tower and development size has increased along with cumulative effect. The county is in the forefront with requirements for annual reports. However, EFSC rules don't require reporting after 2 years. The county relies on some of the EFSC rules, but we don't want to rely on the state to decide how the county is developed. It is important to address issues that the community has been paying environmental costs for already.

Mr. Jolly commenting regarding Commissioner Hansell's concerns about Commissioner Reeder's editorial. He noted that he had just seen Commissioner Hansell in the paper with regards to Washington DC and the environmental issues in the Development Code. We have a lot of wording in the Code about environmental issues, but they feel they don't have the protections in place for the inventoried resources within the county. The proposed changes are a big step forward in that direction. The Blue Mountain Alliance (BMA) and Mr. Jolly personally feel that in the more than 2 years of work by the Planning Commission there has been extensive give and take on both sides. They wholeheartedly back what the Planning Commission has done so far as a step in the right direction. They encouraged the Board to support their effort and accept their recommendations in full.

Regarding fish and wildlife issues, BMA feels that having the monitoring plan and agency representatives involved is a good step for developers to go through in addressing the issues.

Mr. Jolly has attended many EFSC meetings and they are looking to the county for leadership on how the county wants to be developed. They are reactive the county's proposals, which is the kind of government we want. BMA feels that the changes are a step toward protecting the liveability of the county as a whole.

Leo Stewart. Mr. Stewart spoke as Vice Chairman of the Board of Trustees of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The Tribes support the proposed wind power generating facility siting standards. They recognize the importance of renewable energy, but also recognize its impacts. They hope that the rules can meet the challenges of promoting energy development, while preserving the quality of life of the region.

Since the first rules were developed in 1999 the county has been a leader in attempting to preserve our natural resources, and those rules are still viewed as a model to build upon. Over the last decade there has been a dramatic increase in wind development that has resulted in cumulative impacts on natural and cultural resources, which were not foreseen at this scale.

The regulations presented refine and revise the existing rules, based on the experience of wind power development within the region. These rules provide more certainty and defined standards that will benefit both the wind industry and adjacent landowners, while protecting the interests of all county residents.

The Tribes adopted their own energy policy in 2009 recognizing that large scale wind energy projects can impact natural resources or destroy the view shed and quietness of residential areas. They believe the county's draft rules go further than the existing rules to protect important natural and cultural resources. The Tribes understand that the proposed standards do not satisfy all, but they strike an important balance.

If there are revisions in the future, the Tribes would like to see specific requirements for pre construction studies of cultural and natural resources. Once the facility is operational, if it is determined that it has adverse effects on wildlife or other cultural and natural resources, limitations on operations may be imposed. There are also areas that should be studied to determine whether or not they are suitable for wind development. Mr. Stewart pointed out that the things that are most important to quality of life do not change quickly.

Mr. Stewart presented a copy of his testimony. Commissioner Hansell asked if the Tribe has a wind or energy siting ordinance. Mr. Stewart replied that they do have an energy policy, and have a small interest in the Rattle Snake development by Arlington. Commissioner Hansell asked if wind energy siting be allowed on the reservation at this time. Mr. Stewart replied that they had stepped back from that because of concerns among the elders about effects on the cultural and natural resources in the area.

Commissioner Givens moved to add to Mr. Stewart's testimony to the record as Exhibit #41. Commissioner Doherty seconded. Motion carried

Sheldon Kirk. PO Box 239, Weston, OR. Mr. Kirk wanted clarification that the new rules would be effective everywhere. Commissioner Hansell explained that they would be effective countywide. Commissioner Reeder's comments about the Blue Mountains were relative to the possibility of future review and planning which may result in treating the Blues differently.

Mr. Kirk explained that he did not agree with any setback, but the 2 mile proposal in particular could deny him the right to place towers. Landowner who wants towers could be considered second class as well if denied that right. He agreed that the view is beautiful in the Blues, but he wondered what others are giving up for that view. Our communities are hurting for money and so far the towers have brought some money in. Mr. Kirk noted a view tax along the gorge.

Richard Stewart. 515 Fleetwood, College Place, WA. Mr. Stewart owns land in Umatilla County. He noted that the 2 mile setback ends up being a 4 mile radius. Regulation of views and noise are viewed differently by everyone.

Mr. Stewart wondered if the cities had been asked if they agreed with the 2 mile setback. Some cities use wind energy to recharge their city vehicles. He cited an example of a city in California that uses turbines within the city limits for this purpose.

Mr. Stewart asked Commissioner Reeder if the new standards would apply if Red Lion, for example, were to put in a tower for customers to charge their vehicles. Commissioner Reeder explained that the county's wind ordinance applies to commercial use only. It the power generated is sold to another party then it is considered commercial. Senior Planner Carol Johnson added that this ordinance only applies to the rural areas of the county outside the cities. Mr. Stewart talked about regenerating plants in the Portland area for electric vehicles.

Mr. Stewart continued, stating that the 2 mile setback is too far. He felt 1 mile was adequate, noting that turbines get shut down at winds of 40 miles per hour anyhow. He noted that he required locked gates in his contract. Walla Walla County and the city also have not come into the discussion on wind because they know you have to have an economic base to sustain. Mr. Stewart provided a copy of his testimony.

Commissioner Givens moved to add Mr. Stewart's testimony to the record as Exhibit #42. Commissioner Doherty seconded. Motion carried.

Ed Chesnut. 812 Jacqueline St, Milton-Freewater, OR. Mr. Chestnut spoke on behalf of the Milton-Freewater City Council. Umatilla County has the longest history of installed wind projects in the state. The Planning Commission has studied for over 2 years and there has always been a search for knowledge and balance; how do you assure the right to do wind development, while protecting neighbor interests? It is the opinion of the council that the proposed regulations find that balance.

The city of Milton-Freewater is not entirely happy with the setbacks as defined, and there are other issues they would like to see addressed, but they are more concerned that the proposals are enacted soon because development pressures continue to mount. Currently an application would only have to satisfy the requirements of the codes that are adopted right now, which are wholly inadequate. The original setback of 1,320 feet was based on a wind tower of 650 KW, which is 1/5 the capacity of turbines being installed now.

Developers think 2 miles is too much, but the city thinks it's not enough. This probably that means balance is found. The city encourages adoption of the proposed regulations. After two years of Planning Commission study, the Board would need to have very strong reasons not to adopt them.

Finally, because of development pressures and inadequacy of existing standards, Mr. Chesnut urged the Board to consider the need for a declaration of emergency so the rules would take effect immediately. Commissioner Hansell noted for the record that not only was Mr. Chesnut speaking for the council, but he is also a council member.

Jeff Anliker. 325 W Broadway, Milton-Freewater, OR. Mr. Anliker is also a city councilor for the city of Milton-Freewater and represented the council. He noted the importance of the socio economic impact. The ability of the city to expand into its existing UGB over the next 20 years, as well as the continued development of the city as set forth in the state's mandated Goal 9, 50 year plan has failed to be mentioned.

The city supports adoption of the amendments as proposed by the Planning Commission. Mr. Anliker asked that the hard work and research of the Planning Commission over the past two years be recognized, accepted and adopted. It is not exactly what the city wants, but the key is compromise without incurring damage to residents and cities. The city recommends a minimum 4-6 mile physical setback from the UGB and a 15 mile visual setback. There is always the ability for the city to allow them closer if they choose, but it is impossible to allow a 1 mile setback and then ask that turbines be further away when noise, health, and other concerns arise over time. It is always better to err on the side of public safety, especially since we still do not have all the facts regarding the true impact of wind facilities on the public over an extended period of time. The council recommends adoption of the proposed plan.

Tom Buell. Commissioner Doherty explained that Mr. Buell had to leave before testimony, but he let the Board know before leaving that he had intended to testify in favor of wind power.

Sam Hopkins Hubbard. Mr. Chesnut noted that he had to leave.

Scott Graves. 745 Woodberry Lane, Walla Walla, WA. Mr. Graves testified on behalf of Nextera Energy Resources. They feel that the 2 mile setback is excessive. They have plans to build Vansycle III, a 250 million dollar wind project, and their developers believe that the setback would end the project. He noted that the Vansycle II Project provides substantial money to rural communities in the county.

Commissioner Doherty asked what they recommend for a setback. Mr. Graves replied that their development members were not able to attend, so he didn't really have a proposed compromise. Commissioner Hansell asked if Mr. Graves could get a recommendation from the developers and submit that to the Board. Ms. Mabbott asked for a proposed layout as well so staff could include measurements.

Jim Whitney. PO Box 1614, Pendleton, OR. He has towers on his property and deals with Nextera regularly. They have indicated to him that they could live with ½ mile setback. Mr. Whitney personally felt the mileage increase is excessive, and we need to keep in mind what we're trying to accomplish. From the real estate standpoint, there is a point where it is excessive and becomes personal rights versus property rights. There will also be a significant economic shortfall. The decision should not be made today. Mr. Whitney did not feel projects had been given time to provide input.

The county needs to not be involved in wind companies' business. They are spending significant money and they're not going to spend that kind of money unless they have a game plan. We should look at established projects across the nation.

Mr. Whitney did not feel engineered roads are important because they are private. But he agreed that not all private leases include bonds, so we need to be sure that is handled.

Mr. Whitney did not think the issue was about second class citizens as much as land use rights of ownerships. We need to protect property owner rights.

Bob Levy. PO Box 69, Echo, OR. Mr. Levy spoke on behalf of Cunningham Sheep Company. He had already submitted materials to the record. Umatilla County has demonstrated leadership in supporting the utilization of significant resources, and has a history of protecting those resources. This issue is a question of balance of use and lifestyle.

One thing that hasn't been discussed is the difference between rural residential densities in different parts of the county. The proposed amendments impose significant and unreasonable barriers to the maintenance and establishment of wind energy facilities, converting most of the existing renewable energy facilities to non conforming uses and preventing the establishment of new facilities in much of the county. The proposed amendments are a gamble, potentially locking up the wind industry in Umatilla County.

Cunningham asks that the county not adopt the proposed amendments, but leave the existing regulatory program in place, or adopt amendments suggested by RES or Element Power. Cunningham would be adversely affected by the proposed setback because they have leases in place with companies to develop facilities on their properties and the terms of their leases were developed with reasonable expectation that the county siting regulations would not prohibit or be changed. It is significant that under those leases they received approval from the County Planning Department for the siting of the MET towers, and several studies have been done on the strength of the county's regulations that were in place at the time.

There are several reasons not to adopt the proposed amendments. One is that they are unlawful and require significant adjustments. Another is there are a lot of changes in words. It is kind of like changing the rules as we go along. It is very important that the words leave no misinterpretation (i.e. shall/may).

It is also disappointing that the Planning Commission document is being recommended to the Board for approval, but Mr. Levy did not get the impression that it is actually a final approval. It feels more like a work session.

Mr. Levy passed out a map of 65,000 acres in Umatilla County north of Pendleton, with 2 mile circles around residences in that area. He pointed out the cumulative effect of multiple 2 mile circles. There is nothing left that is not covered. Certainly there are areas that need to be protected, but this seems burdensome.

The proposal is confusing, and duplicates the work of state and federal agencies, adding excessive burden on the county. Mr. Levy requested that the Board take time to consider the implications before locking up the wind resource.

Commissioner Hansell asked if all projects that have leases that have been sited under the current rules are grandfathered. Ms. Mabbott replied that if a project is already permitted then they are ok. The rules are not retroactive. An application submitted a few weeks ago is subject to the existing standards. Commissioner Doherty added that the key date is when the application is filed, not when it is permitted.

Commissioner Hansell asked about the possibility of creating a map of the whole county similar to the one submitted by Mr. Levy. Commissioner Doherty commented that the point Mr. Levy appears to be making with the map is that the location of a home dictates where a tower can be. Ms. Mabbott added that, to some extent that is how it is now, in order to comply with the state noise standard. Commissioner Hansell pointed out that it is a different radius than what is proposed though.

Commissioner Givens moved to add the map as Exhibit #43. Commissioner Doherty seconded. Motion carried.

Ms. Mabbott clarified with Mr. Levy about Cunningham's recommended setback, which he previously stated was based on RES and Element Power's recommendations. Element Power recommended 3,520 from a residential zone and 1,320 from a residence. Mr. Levy replied that he did not believe they would support the 3,520, but it would depend on visual and other factors. Commissioner Reeder noted that 1,320 is ¼ mile, which is the EFSC standard. Mr. Levy personally supported ½ mile.

Joy Potter. 1206 N Dollar Way Road, Ellensburg, WA. Ms. Potter spoke on behalf of Horizon Wind Energy. The revisions as presented will result in negative impacts to residents who seek to harvest wind energy, as well as reduce revenue in the county. The proposed setbacks have the potential of eliminating future projects. Horizon Wind submitted comments on November 16th, 2010 and February 14th, 2011 and Ms. Potter urged the Board to review those.

Ms. Potter submitted a letter on behalf of a landowner who could not attend. He desires to harvest wind energy from his property. She also asked if written testimony would be closed after the meeting. Commissioner Hansell explained that the record would be kept open and there would be opportunity for both sides to provide additional comments.

Ms. Mabbott noted that Horizon's recommended setbacks were 3,520 from a residential zone and 1,320 from a residence. Ms. Potter explained that they agreed with what RES and Element Power suggested. If allowed written testimony, she would confirm that. Ms. Mabbott stated that Horizon had already indicated these setbacks in their November 16th, 2010 letter. Commissioner Hansell noted that the decision to continue testimony is

usually made at the end of the hearing, but the Board had already discussed and would be keeping the record open.

Commissioner Doherty moved to add the Tsiatsos letter to the record as Exhibit #44. Commissioner Givens seconded. Motion carried.

Paul Landers. Touchet Gardenia Rd, Touchet WA. Mr. Landers spoke on behalf of Nextera Energy. He agreed that a setback of 2 miles would effectively kill the Vansycle III project. Also, he pointed out that there are other impacts that are positive to the community. Roads are put in that help area farmers get their product out; they support communities financially; and as a whole, the community benefits from the increased tax base. They want to be good neighbors and are active in the community.

Mike Odman. Mr. Odman declined to testify.

Cindy Severe. 82422 Vansycle Rd, Helix OR. Ms. Severe indicated her home on the colored map; R13. The map does not show that on the opposite ridge there are 26 of the first towers that went in, in 2000. The new project would surround them by another 100-134 large towers. As a landowner it has been difficult because of the secrecy and how the companies put the projects together. She does not oppose her neighbor profiting from their land, but she likened it to her deciding to put a dump right on property line, upwind from her neighbor. The neighbor would have all of the negative effects.

The setbacks proposed by developers are totally unacceptable. Her family is living it and she implored the Board to consider that, on one hand there are the wind companies and a small group of landowners that want profit from wind, and on the other there are the residents who are impacted. They can hear the four big turbines that are already there over 1 ½ mile away. They could potentially be surrounded by 134.

People who are uneducated and don't understand might sign the proposed leases, not realizing the impact. Plus, they include a non disclosure clause, which is completely unethical. Ms. Severe asked if any of the commissioners want turbines surrounding their own homes. There is a human element. It's not just wildlife and natural resources. As elected officials, the Board is charged with the welfare of the whole county, not just landowners who want the wind, and developers.

Ms. Severe thanked the Planning Commission for their efforts and urged the Board to consider everything. ¼ mile is not enough. Commissioner Hansell asked if Ms. Severe was supportive of the proposal currently before the Board. She agreed.

Debbie Kelley. 146 SE 11th Ave, Milton-Freewater, OR. Ms. Kelley read aloud a letter from Blue Mountain Alliance. They support the document prepared by the Planning Commission and urged the Board to support it as well.

Ms. Kelley noted the map shown today does not show towers already in place. The cumulative effect doesn't seem to be taken into account with the siting of new projects.

She understands it is an EFSC approval, but Umatilla County should have standards for them to consider. Citizens are relying on county leaders to "not put all our eggs in one basket" and look for other sources of revenue for the county.

The state has arbitrarily removed hydro power from renewable energy. They have also formally designated [EFU] and forest/grazing lands as industrial zones. Wind turbines do not "farm" the wind. Is the wind developers' money worth the long term harms the to the county? The proposed document will set a precedent, protecting all property owners. Letting the wind industry continue to write the rules and regulations that our citizens must live with is unacceptable.

Commissioner Givens moved to add the letter from Blue Mountain Alliance to the record as Exhibit #45. Commissioner Doherty seconded. Motion carried.

Sarah Curtiss. 900 SW 5th Ave, Portland, OR. Ms. Curtiss is an attorney with Stoel Rives speaking on behalf of Element Power. In November of 2010 Element, along with other wind developers, provided the Planning Commission with a red line of the proposed amendments; the purpose being to help document the interplay between the county planning process and that of EFSC, as well as to address substantive changes, propose recommendations, and encourage the county to look to the precedent EFSC has set. Ms. Curtiss stated that these comments were not considered. Element asks that the red line be considered, and the Board either adopt or provide an explanation why it is rejected.

The Energy Generation Area (EGA) was removed in 2010 through an EFSC rulemaking. The county initiated this rulemaking request to remove the economic and financial disadvantages for development of wind within the county. Umatilla County was the only county in the state with an EGA. As proposed, the draft amendment risks placing the county at a competitive disadvantage for wind development. The proposed changes impose subjective requirements that provide no certainty for developers.

Element has recommended that the county adopt the standards consistent with what EFSC has already found to be protective of human health, public safety, wildlife, and public services. To the extent the county chooses to deviate from EFSC standards, the county needs to provide explanation or rational basis for doing so. This explanation may not be based purely on speculation and assumptions, but sound, professionally recognized and accepted science.

Ms. Mabbott advised Ms. Curtiss that every piece of information submitted to the record had been reviewed. The Planning Commission did not necessarily agree with all comments, but certainly they were all considered. Ms. Curtiss replied that Element would like to urge the Board to look at the comments that were previously made because many of those issues remain. Ms. Mabbott noted that they were included in the Board's packet for their consideration. She added for the record that Element has recommended a 3,520 foot setback from a residential zone and 1,320 from a residents. Ms. Curtiss clarified that it is important to distinguish between rural residences, and those that are actually in a residential zone, which is a more densely populated area.

Commissioner Reeder noted that he has a 30 page report that will explain all the details as to why the developers' comments were not included in this draft ordinance. Once this document is complete it will be put on the county website. It was noted that it was included in the exhibit list as Exhibit #3, although it is not complete. It had been accepted to the record as such.

Commissioner Doherty asked Ms. Curtiss if the disadvantage she mentioned was economic or competitive. Ms. Curtiss replied that it would be a competitive disadvantage because these standards will put the developers in a position where it might not be financially viable to locate in Umatilla County and they might consider developing elsewhere. Commissioner Givens also advised that the EGA was removed not just for economic reasons, but also to provide the citizens and county with a voice.

Ron Brown. 84156 Winesap Rd, Milton-Freewater, OR. Mr. Brown wanted to draw attention to the watershed topic. He submitted a letter from the Walla Walla River Irrigation District, who he represented today as Chairman of the Board. In 2000 they were sued by US Fish and Wildlife for threatening resident fish species in the river. Hudson Bay and Walla Walla River Irrigation Districts had to contribute 30% of their water back into the stream to protect the fish, and spent 3.5 million dollars on a habitat conservation plan that is not yet complete.

Watersheds are very sensitive areas. He has provided speakers and science to the Planning Commission so they could make sound decisions on that specific area. Mr. Brown supports having the other agencies named in the proposed draft included in the pre-application meeting. The Clean Water Act trumps everything, and the county rules are not strong enough to protect the water shed. The topography is much different in this area than any other place in the county. Basalt wells may be impacted by development, and there are sensitive areas that need to be examined before development should be allowed. Mr. Brown was also concerned about runoff from roads and the cumulative effect.

Mr. Brown cited the example of the Walla Walla River being mined in the 1950s and today the water put back onto the stream seeps out of that hole. When the irrigation district was sued he asked that the mining area be looked at, but the company no longer exists and there was no bond. So the district paid for it. He supports the bond for decommissioning, and supports involving the Tribes, watershed councils, and other groups in protecting the sensitive areas.

They do not want the regulatory agencies coming down on people for putting anything into the river. It is important to think about future generations and the long term effects. The sensitive areas require a lot more restriction and we need to look at them now because we can't go back and undo. Mr. Brown is not against wind towers, but he is against putting them up without studying the areas where they will be located. Wind power companies are exempt from having to put together an environmental impact statement.

Commissioner Doherty asked what the "white paper" is. Mr. Brown responded it is a publication that came out two months ago about water future, and putting minimum flows in all rivers in Oregon. He would submit a copy for the Board.

Jeff Newtson. 82106 S. Juniper Canyon Rd, Helix OR. He is a landowner and used to live 1 ½ to 1 ¾ miles from the FPL project area. While living there they could see the turbines from their home. They could hear them outside the house, but not inside, and they did not seem to pose any health concerns to his family.

He was concerned about property rights being impacted by the proposed ordinance. He agreed there should be setbacks, but not as far as 2 miles. He would like to see an economic analysis done on the proposal and a comparison done on how the 2 mile setback would look if applied to the turbines already up, and how it would affect community budgets.

Mr. Newtson is a board member of the Helix Fire District. Their budget is increased due to the income from wind projects. Money from wind projects has also helped the parks, cemetery, school and city of Helix. He wants to see an economic analysis done to show how much good the wind projects have done for their community. Wind is a way for him to diversify his farm. Mr. Newtson noted he has a surety bond in his own contract with the project, but felt the additional requirement for a bond with the county is excessive.

Mr. Newtson noted that there are homes on the Iberdrola map that are not occupied and have not been for quite some time. The propose turbine placements are not set in stone. There are many property owners who will not sign the noise easements, so there will not be new towers near these people.

He invited the commissioners to go out and see a turbine up close. How else will this county be able to provide services if not for the wind project income, and that is why he wants to see an economic analysis done to show the good done. Commissioner Givens advised Mr. Newtson that he is very familiar with what a tower looks like up close, and lives near them as well.

Commissioner Doherty asked Mr. Newtson if he thought Cindy Severe's concerns were not factually based. Mr. Newtson replied that he was not saying her statements aren't true, but was pointing out that the turbines are just dots on a map right now. If people in that area won't sign the noise easements, the developer won't come in because they don't want to deal with legal issues in the future.

Ms. Mabbott advised that Mr. Newtson is correct. Iberdrola would comply with EFSC standards only if they get signed noise easements from the affected land owners within the noise standard boundary shown on the map.

Commissioner Givens moved to add the testimony from Sarah Curtiss, Stoel Rives to the Record as Exhibit #46, the letter from the Walla Walla River Irrigation District as Exhibit #47, and the letter from Jeff Newtson as Exhibit #48. Commissioner Doherty seconded. Motion carried.

Dana Perkins. 79297 Gerkin Flat Rd, Athena, OR. Ms. Perkins and her husband are property owners in Umatilla County. She agreed with the previous speaker's comments, and feels the projects provide revenue that is beneficial for schools and communities. She believes that the proposed ordinances will be a detriment to future wind developers and Umatilla County will lose money. She respects property owners' rights who don't want them near their property, but wants her right to have turbines respected as well.

Ryan Stoner. 121 S Joliet, Kennewick, WA. Mr. Stoner spoke with Carrie Stanley who did the noise study in Morrow County and all the homes in that lawsuit were over 1 mile away. Obviously 2 miles is not excessive. Also, the setback doesn't say turbines can't be placed, just that the developer has to have an easement from the landowner.

Mr. Stoner also disagreed with having a different setback between city and rural. He supported the Planning Commission in all their hard work over the past couple of years.

Chase Whitney. 1125 NW Couch St, Ste 700, Portland, OR. Mr. Whitney spoke on behalf of Iberdrola Renewables. He offered clarification to the noise figures, Figures 1 and 2, submitted to EFSC in Iberdrola's amendment. Mr. Newtson was correct that it is essentially just dots on a map. They would have to successfully negotiate a noise easement with the homes in order to be in compliance with the noise standard.

Mr. Whitney appreciated that Commissioner Reeder used that map to help substantiate the 2 mile setback, but it is important to clarify that if they are not successful in reaching a noise easement, under current rules that will impact the Helix project with EFSC, they will have to redesign the facility. The state rules will largely already facilitate the setback. Ms. Mabbott asked if Mr. Whitney had stated or implied that the map was not the final noise contour map. Mr. Whitney replied that it was submitted with their application as a maximum and minimum, encompassing the range of turbine size that they anticipated using in the project. They are likely not going to be successful in reaching easement agreements with landowners, so they will have to conduct a new study as a condition of their EFSC site certificate.

Commissioner Reeder noted that EFSC's reply to the closing statement of Iberdrola's application is that they meet the noise standards "if" they get the noise easements. What Mr. Whitney is saying is that they are required by state standard to make sure the homes are outside the noise boundary, so they would have to generate a noise map showing that the homes are outside the boundary. Mr. Whitney added that this is under the current rules according to EFSC standards. The Willow Creek Project in the Carrie Stanley example was not permitted through EFSC and therefore not subject to EFSC standards. Commissioner Doherty commented that they didn't have standards in that county.

Commissioner Doherty noted that testimony indicated that the drive for the need for new standards is that turbines are growing. He wondered if Mr. Whitney thought towers would continue to grow or if they are getting to their max. Mr. Whitney replied that you run into size constraints for transportation of components to the sites, but it is beyond his realm of knowledge to say for sure. He felt it worth noting that the 1,320 setback recommended by EFSC is a minimum. It is typical for turbines to be further than that. He believed the noise standard does provide an effective means of designing a setback from homes and allowing individual landowners to have a voice.

Commissioner Hansell explained that the record would be kept open for those who wish to provide additional testimony. He asked Commissioner Reeder how and why 2 miles was chosen, and if there is clear science that would back it up. Commissioner Reeder replied that the number came up in both a meeting and work session. The Planning Commission had been wrestling with the setback issue for a long time and Commissioner Reeder had taken his own video clips from various areas. He read through the research in Morrow County and those who live within the vicinity of a tower don't want them closer than 1 mile. 2 miles on the downwind side is not excessive, but that is only relative to prevailing wind. 20 times the tower height takes into account the tower height and ends up being about 2 miles with the current towers. If using 1 mile, the study in Morrow County indicates that it is not enough. To truly protect under any circumstance, 2 miles does that. To ensure the homeowner gets a say, the two miles requires the development to acquire an easement and compensate. Potentially we have a state agency looking at health effects and there are increasing numbers of articles shadow effects.

The Planning Commission meeting that the recommendation came from was unanimous that we need to move on. There is no justification not to use two miles, and it doesn't necessarily prohibit towers. Power companies are now more aggressively seeking the noise easements. Tower can be as close as a landowner is willing. The Planning Commission didn't see a downside because it is not prohibiting, but allows neighbors a say.

Commissioner Hansell commented that what was heard in testimony today is that there actually is a downside because 2 miles would shut the door on wind development. If under the state rules people aren't signing noise easements then they probably won't at 2 miles. Commissioner Reeder agreed, noting that it's a typical public utility issue. There is a public benefit, a need for the energy, but it is bigger than just an energy issue.

Commissioner Doherty asked about the size of the facilities in the Morrow County case that produced the noise issue. Ms. Mabbott replied that they were 1.5 MW. Commissioner Doherty noted that it is possible that the industry may trend toward smaller towers and wondered if the 2 mile setback would still be necessary. Commissioner Reeder replied that if the towers are smaller and noise shrinks with it, 2 miles would be excessive. Commissioner Doherty pointed out that there is nothing in the proposal to compensate if the towers are smaller. He was concerned that it creates a one size fits all.

Commissioner Hansell asked if a property owner can say no now at ¼ mile. Commissioner Reeder explained that it is the state standard at work now, and no setback is really at work because all of the homes are more than ¼ mile inside the noise boundary. So it's the size and location of the tower because it's the noise standard that is ultimate in this case. Commissioner Hansell wondered why we're worried about the setback if it's not going to make a difference. Commissioner Reeder replied that in the Morrow County case the towers were not built to satisfy the noise standard, but they didn't because they didn't require the noise study ahead of time. Ms. Mabbott noted that it is not compulsory the way our amendment is stated. Commissioner Reeder suggested that it could be required here as at the state level.

Ms. Mabbott pointed out that there are other reasons than noise for setbacks, such as visual. Planning Commissioner David Lynde commented that the Planning Commission heard testimony from Cindy Severe that her horses are affected by vibrations and motion. There is still a lot of science to the issue. Commissioner Reeder added that livestock may not hear the sound, but feel it through their bones. Commissioner Lynde noted that Fish and Game has indicated in previous meetings that deer don't appear to be quite as affected as elk, but with more facilities, that data is changing.

There was a comment from the floor that towers are probably as big as they'll get. They can't get much bigger due to transportation issues.

Commissioner Hansell asked if there are any other jurisdictions that have a 2 mile setback. Commissioner Reeder replied that a lot of things have been talked about and the world is increasingly interested, but there's not been a lot of research. Europe's opposition is very similar to what we're seeing here. Ms. Mabbott offered to provide an answer at a later time. She has notebooks of other jurisdiction's regulations.

Commissioner Reeder noted maps showing where all the wind development is in the county, including MET towers. There is a strong need to look at the cumulative effect.

Mr. Chesnut asked about the ability to get DEQ to investigate violations of their own noise ordinance. Ms. Mabbott replied that there is none. They have no staff to enforce the noise standard. That's then you end up with a situation like in Morrow County where residents had to hire their own noise consultants.

Commissioner Hansell noted that the Board would keep the record open. Ms. Mabbott noted a couple of dates already reserved for continuation; April 26th or May 12th. There was discussion about the date and it was decided on May 12th at 9:00 a.m. at the Justice Center.

Mr. Levy asked if the Planning Commission would draft a new proposal or keep the current one. Commissioner Hansell explained that if there was a redraft it would come from the Board. Planning Commission has done their work and the Board will work with Planning Commission representatives and staff.

There was discussion about how long the record would remain open. County Counsel Doug Olsen suggested a deadline to allow the Board time to review, but pointed out that additional testimony can be taken at the continued hearing. Commissioner Givens suggested recommending written testimony be submitted before April 15th. Commissioner Hansell added that it would behoove people to submit materials before April 15th for it to be considered before a work session. Staff will schedule a work session sometime after April 15th, but before the May 12th continuation. Commissioner Reeder noted that most testimony has stayed the same since October 2010, and he did not anticipate substantive changes in testimony.

Commissioner Hansell recessed the hearing until 9:00 a.m. on May 12th, 2011 at the Umatilla County Justice Center.

ADJOURNMENT:

The meeting was adjourned at 4:50 p.m.

Respectfully submitted,

Heather Haueter
Secretary

March 17, 2011

To the Umatilla County Commissioners,

I am writing this letter in response to the Umatilla Planning Commission's proposals to amendment UCDC 152.615 and 616. I am very concerned with the direction the commission is heading with the limits they are suggesting for wind tower setbacks. I lived within a mile and a half from the Stateline Project for seven years. I have since moved to be closer to my shop. I could see the wind turbines from my home but could not hear them. I farm next to the project and am surprised every time somebody suggests that the turbines make too much noise. There is more noise created from the wind itself and have noticed that the new larger turbines being placed in the county make less noise than the faster turning older turbines.

The setbacks being suggested of two miles seem too much if we want to continue encouraging any development in the future. Many communities have benefited greatly with new jobs, increased funding for special districts, and city and school building funds. The county has also seen their budgets increased and have been able to keep key programs funded. I feel the state rules that have been used for setbacks should be sufficient for our county.

I also do not like the proposed changes to the wording of decommissioning the wind towers. At one time the decommissioning fund included the landowner as beneficiary. Now it only includes Umatilla County! The towers are on private property. Leases signed by landowners should have decommissioning security wording in them like the one I signed. The money does not get lost in the county coffers but is secured for the landowners.

The erosion of property rights is of great concern to me. I would hate to see more overreaching laws proposed that limit our ability to bring jobs to the area and income to our small communities.

Sincerely submitted,

Jeff Newtson

Testimony re Proposed Amendments to Wind Power Ordinance

March 17, 2011
Sarah Stauffer Curtiss, Stoel Rives LLP (on behalf of Element Power)

Good morning and thank you for the opportunity to provide testimony regarding the proposed amendments to the County Wind Power Ordinance. My name is Sarah Stauffer Curtiss. I am an attorney with Stoel Rives and am here on behalf of Element Power, a Portland-based renewable energy developer of utility-scale wind and solar projects.

As an initial matter, Element requests the Board to consider its prior comments. In November 2010, Element, along with other wind developers, provided the Planning Commission with a redline of the proposed code amendments. The purpose of the comments was twofold: (1) to help document the interplay between the county's permitting process and that of the state Energy Facility Siting Council, and (2) to address substantive changes and encourage the County to look to the precedent EFSC standards as example for what to include in its code. These comments were not considered. Element asks the Board to consider this redline and either adopt its recommendations or explain in the record why it is rejecting the suggestions.

Second, Element urges the County to consider the economic consequences of its actions. In 2010, the Umatilla County Energy Generation Area was removed through an EFSC rulemaking. The County initiated this rulemaking request to remove the economic and financial disadvantages for development of wind within the County. (The County was the only county in Oregon with an EGA and saw it as a competitive disadvantage when compared with the other 35 counties in the state.) As currently proposed, the PC's recommendations risk putting the County again at a competitive disadvantage for future wind development. For example, the proposed changes would impose subjective requirements that provide no certainty to a developer and potentially require years of undefined mitigation or monitoring.

Third, adopting standards consistent with current EFSC standards is appropriate. During this process, Element has recommended that the County adopt standards that are consistent with what EFSC has already found to be protective of public health and safety, wildlife, and public services. The precedent surrounding the EFSC standards provides the County with a rational basis for adopting the standards into the UCDC. To the extent the County chooses to deviate from EFSC standards (whether the County chooses to toughen or weaken a standard), the County needs to provide some explanation, or rational basis, for doing so. Otherwise, such deviations risk being rejected as arbitrary and capricious. This explanation cannot be based purely on speculation and assumptions, which is what we have seen throughout the Planning Commission process, but must be based on sound professionally-recognized and professionally-accepted science.

Fourth, there is no evidentiary basis upon which to increase setbacks based on the argument that turbines decrease property values. Indeed, there is evidence to demonstrate that wind does not impact residential property values. This conclusion is based on a scientific analysis based on

hedonic and statistic modeling done by the Lawrence Berkeley National Lab. I have brought a copy to submit to the record.

With respect to the specific provisions, Element has the following comments:

Setbacks from City Limits. The PC proposes a 2 mile or 20 times tower-to-blade tip height setback from city limits, whichever is greater. However, the current 3,520-foot setback for properties zoned for residential use is an appropriate setback for city limits. In other words, a 3,520-foot setback has proven to be sufficiently protective of properties zoned for residential use, this same distance is also sufficiently protective of uses within city limits as well.

Setbacks from Non-Agricultural Land Use Zones. The PC proposes a 10 times tower-to-blade tip height setback from unincorporated community zones and proposes to delete the requirement for a 3,520-foot setback from all properties zoned for residential use or designated on the Comprehensive Plan as residential. Element again proposes that the County maintain the current 3,520-foot setback from properties zoned for residential use, and would propose that this setback also be applied to the unincorporated community zone as these zones are also used for residential use. Again, we feel that this setback has proven to be sufficiently protective of residential uses.

Setbacks from Residences in Agricultural Land Use Zones. The PC proposes a 3,520-foot setback or 10 times tower-to-blade tip height setback (whichever is greater) from rural homes, although what constitutes a rural home is left undefined what constitutes a rural home. If the PC Draft is intended to refer to rural homes in rural residential zones, then we believe the County should simply preserve its current setback of 3,520 feet from properties zoned for residential use, for the reasons stated above. For rural homes in agricultural zones, however, the setback should be less. The purpose of agricultural zone is to promote and protect agricultural production. In an agricultural zone, the question is whether a proposed wind energy facility is compatible with accepted farming practices, not residential use. In fact, residential use in the agricultural zone can be subject to land use review, just like a wind energy facility, to ensure compatibility with accepted farming practices. It is statewide policy to encourage wind developers to site on agricultural lands and the PC Draft's approach of imposing urban-like setbacks for residences on lands zoned for agricultural production is counter to this policy. Element suggests that the County adopt a 1,320-foot setback from existing residences on lands zoned for agriculture, which is a setback distance that has been found to be sufficiently protective of public health and safety.

Setbacks from Roadways. The PC proposes a 2 times tower-to-blade tip height setback from county road rights-of-way (measured from the boundary of the right-of-way) and a 3 times tower-to-blade tip height setback from state or interstate highway rights-of-way (measured from the boundary of the right-of-way). There is no basis to create a distinction between county, state, and interstate highways when imposing a roadway setback, if the purpose of the setback is to protect public health and safety. As with the other proposed setbacks, there does not appear to be any basis for these proposed setback distances. Element recommends that that the County adopt a 110 percent of blade-tip-height, measured from the centerline of the turbine tower to the nearest edge of the right-of-way.

Setbacks from Cultural or Archaeological Sites. The PC proposes a 2 times tower-to-blade tip height setback from archaeological or cultural sites. Element believes that setbacks from cultural or archeological sites should be developed on a site-by-site basis depending on the site conditions, the nature of the resource, and the proposed activities in proximity to the resource.

Setbacks for Transmission Lines. The PC proposes a 500-foot setback for new electrical transmission lines from existing residences (unless in the public right-of-way). EFSC has previously imposed conditions requiring a 200-foot setback from existing residences, and without justification for why a 200-foot setback is inadequate to be protective of public health and safety, we believe the County should adopt this same 200-foot setback rather than a 500-foot setback requirement for aboveground transmission lines.

For these reasons, Element respectfully requests the Board to defer a decision on the proposed amendments for further consideration of these issues. Thank you for your time and I am happy to answer questions.

The Impact of Wind Power Projects on Residential Property Values in the United States:

A Multi-Site Hedonic Analysis

Ben Hoen, Ryan Wiser, Peter Cappers, Mark Thayer, and Gautam Sethi

Lawrence Berkeley National Laboratory

December 2009 (revision #1)

This analysis was funded by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Wind & Hydropower Technologies Program

00003588

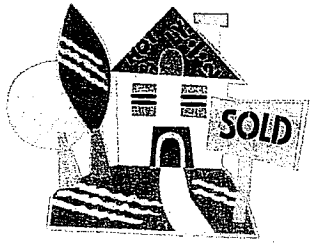
The Impact of Wind Power Projects on Residential Property Values in the U.S.

- Motivation and Study Methods
  - Motivation
  - Overview and Methods
  - Data Summary
- Summary of Analysis Results
- Conclusions and Further Research

00003589



Proximity to and Views of Environmental (Dis)Amenities Can Impact Property Values

Highway	Transmission Lines	Average Home	Green Space	Ocean Front
↓$	↓ $		↑$	↑$

This linkage is well studied generally, but not for wind power facilities

00003330

Aesthetics and Property Values Rank as Key Concerns for Wind Stakeholders

"Aesthetic perceptions, both positive and negative, are the strongest single influence on individuals' attitudes towards wind power projects." (Warren, 2005, p. 853)

US developers rank aesthetics & property values as the #1 and #3 concerns of those in opposition to wind development (Paul, 2006)

100% and 85% of those opposed to offshore wind development believe aesthetics and property values, respectively, will be adversely impacted (Firestone et. al., 2007)

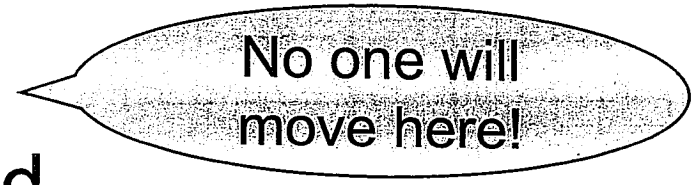
Having structures on the Vermont hilltops was considered a "big disadvantage" by the majority of those surveyed before the Searsburg, VT wind facility was erected (Palmer, 1997)

00003591



Property Value Concerns for Wind Energy Fall Into Three Potential Categories

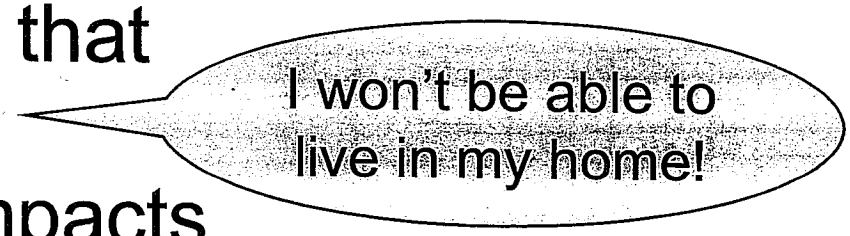
1. **Area Stigma:** Concern that rural areas will appear more developed



2. **Scenic Vista Stigma:** Concern over decrease in quality of scenic vistas from homes



3. **Nuisance Stigma:** Concern that factors that occur in close proximity will have unique impacts



Each of these effects could impact property values; none are mutually exclusive

28530000

Relatively Few Existing Wind and Property Studies: A List of the Most Publicized

- **Variety of methods used**, from surveys to sales analyses, with varying levels of sophistication
- **Results are diverse**, and in many instances unpersuasive due to limitations in data and methodology

Document Type Author(s)	Year	Number of Transactions or Respondents	Before or After Wind Facility Construction Commenced	Area Stigma	Scenic Vista Stigma	Nuisance Stigma
Homeowner Survey						
Haughton et al.	2004	501	Before	- *	- *	
Goldman	2006	50	After	none		
Firestone et al.	2007	504	Before	- *	- *	
Bond	2008	~300	After		- ?	- ?
Expert Survey						
Grover	2002	13	After	none		none
Haughton et al.	2004	45	Before	- *	- *	
Khatri	2004	405	Before‡	- ?		- ?
Goldman	2006	50	After	none		none
Kielisch	2009	57	Before‡			- ?
Transaction Analysis - Simple Statistics						
Jerabek	2001	25	After			none
Jerabek	2002	7	After			none
Sterzinger et al.	2003	24,000	After	none		
Beck	2004	2	After			none
Poletti	2005	187	After	none		none
DeLacy	2005	21	Before†	none		
Goldman	2006	4	After	none		
Poletti	2007	256	After	none		none
McCann	2008	2	After			- ?
Kielisch	2009	103	After			- ?
Transaction Analysis - Hedonic Model						
Jordal-Jorgensen	1996	?	After			- ?
Hoen	2006	280	After		none	
Sims & Dent	2007	919	After			- *
Sims et al.	2008	199	After		-/+ *	

"none" indicates the majority of the respondents do not believe properties have been affected (for surveys) or that no effect was detected at 10% significance level (for transaction analysis)

"- ?" indicates a negative effect without statistical significance provided

*"- *" indicates statistically significant negative effect at 10% significance level*

*"-/+ *" indicates positive and negative statistically significant effects at 10% significance level*

† *Sales were collected after facility announcement but before construction*

‡ *Some respondents had experience with valuations near facilities while others did not*

00003593

Limitations of Existing Research

- **Many studies have relied on surveys** of homeowners or real estate professionals, rather than quantifying real impacts based on market data
- **Most studies have relied on simple statistical techniques** that have limitations and that can be dramatically influenced by small numbers of sales transactions or survey respondents
- **Most studies have used small datasets** that are concentrated in only one wind project study area, making it difficult to extrapolate findings
- **Many studies have not reported the statistical significance** of their results, making it difficult to determine if those results are meaningful
- **Many studies have concentrated on Area Stigma**, and have ignored Scenic Vista and/or Nuisance Stigma
- **Only a few studies have included field visits** to homes to determine wind turbine visibility and collect other important information
- **Only two studies have been published** in peer-reviewed journals

0003594

The Impact of Wind Power Projects on Residential Property Values in the U.S.

- Motivation and Study Methods
  - Motivation
  - Overview and Methods
  - Data Summary
- Summary of Analysis Results
- Conclusions and Further Research

00003595

Berkeley Lab Project Involves Most Data-Rich and Comprehensive Analysis To Date

Research Questions

1) Is there evidence that views of turbines measurably affect sales prices?
2) Is there evidence that proximity to turbines measurably affect sales prices?
3) Do the results change over time, and are there other observable impacts?

Relevance

Provides stakeholders in siting/permitting processes greater confidence in the likely effects of proposed wind energy facilities, allowing greater consensus on often-contentious setback requirements and viewshed valuations

Team

B. Hoen (Subcontractor to LBNL), R. Wiser (LBNL), P. Cappers (LBNL), M. Thayer (San Diego State University), G. Sethi (Bard College)

Funder

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Wind & Hydropower Technologies Program

00003596

Research Approach Responds to Limitations of Previous Work

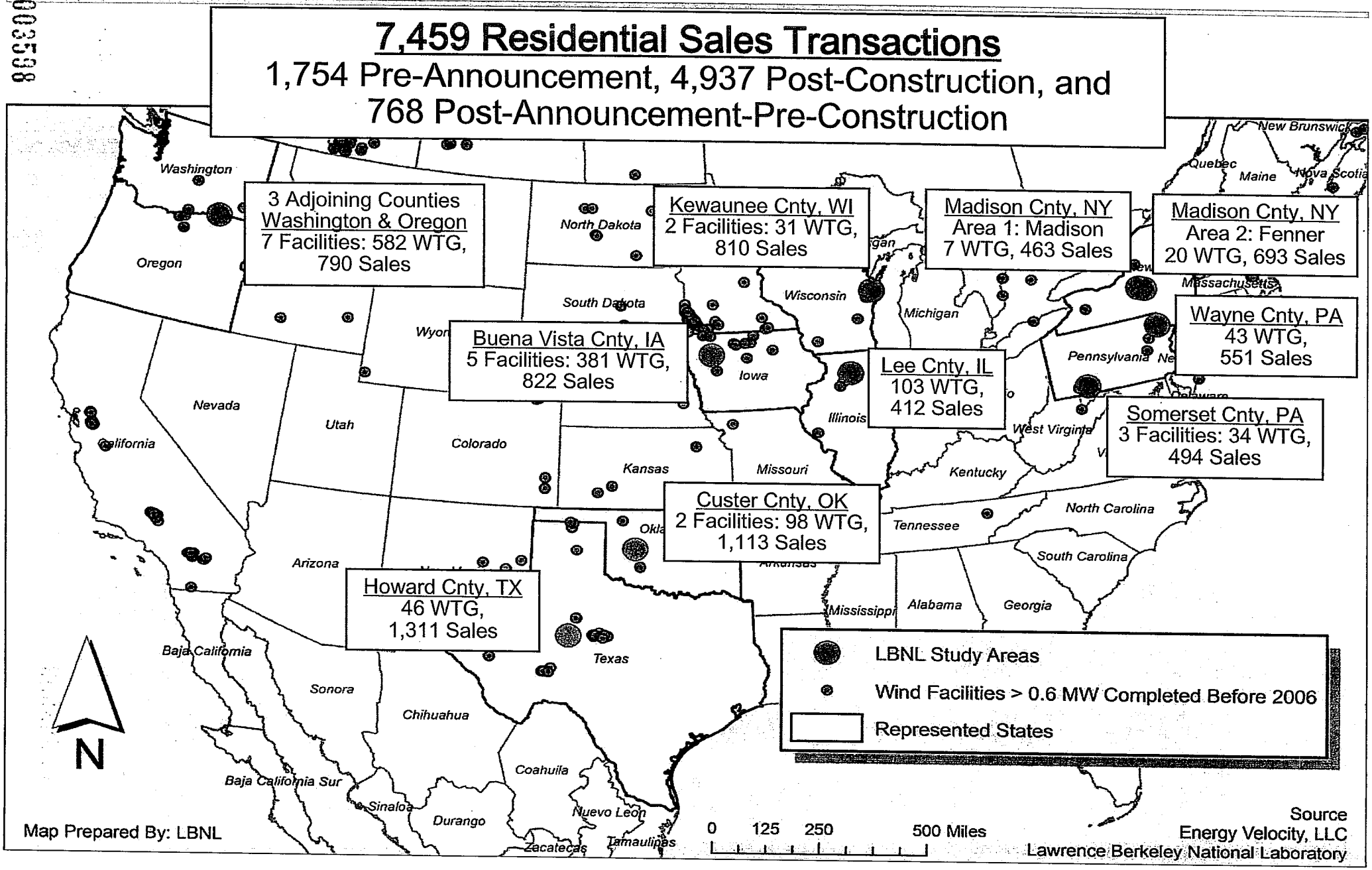
- **Conduct literature review** of previous wind / property value studies and wind facility public acceptance surveys, as well as potentially analogous studies on other disamenities (e.g. roads, power lines, power plants)
- **Collect large amount of data** on residential sales transactions occurring both pre- and post-construction surrounding a **representative sample** of wind facilities at **multiple locations** in the U.S.
- **Visit each home** to determine wind turbine visibility and to collect other important information about the home (e.g., the quality of the scenic vista)
- **Use multiple statistical models** to explore magnitude and statistical significance of potential effects, relying primarily on **hedonic model**
- **Test for the presence of all three stigmas** – Area Stigma, Scenic Vista Stigma, and Nuisance Stigma
- **Rigorously analyze** the data, culminating in an LBNL report and at least one journal paper

00003597



Collected Sales Data from 10 Study Areas Surrounding 24 Wind Facilities in 9 States

00003598



00003599

Research Relies on Hedonic Pricing Model in Addition to Other Models

	Coef.	SE	p Value	n
Intercept	7.62	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.33	0.04	0.00	87
Cnd_Low	-0.45	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.14	0.01	0.00	1,445
Cnd_High	0.23	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.03	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.24	0.02	0.00	605
ILLC	-0.09	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.07	0.03	0.01	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
Post_Con_NoView	Omitted	Omitted	Omitted	4,207
View_Minor	-0.01	0.01	0.40	561
View_Mod	0.02	0.03	0.58	106
View_Sub	-0.01	0.07	0.94	35
View_Extrm	0.02	0.09	0.80	28
Mile_Less_0_57	-0.05	0.06	0.40	67
Mile_0_57to1	-0.05	0.05	0.30	58
Mile_1to3	0.00	0.02	0.80	2,019
Mile_3to5	0.02	0.01	0.23	1,923
Mile_Gtr5	Omitted	Omitted	Omitted	870

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	1
Dependent Variable	LN_SalePrice96
Number of Cases	4937
Number of Predictors (k)	37
F Statistic	442.8
Adjusted R Squared	0.77

What Is a Hedonic Pricing Model?

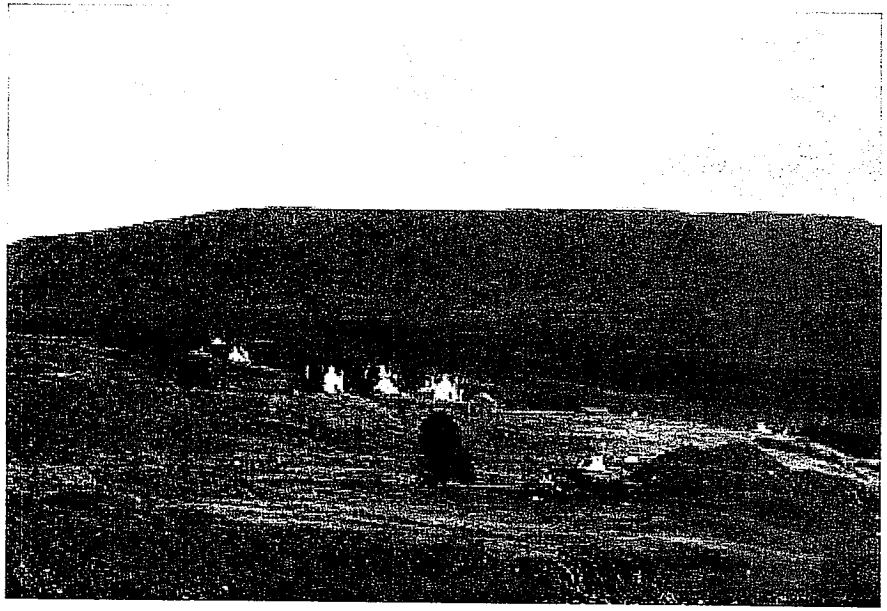
- **Well respected model** used by economists and real estate practitioners for over 40 years
- **Heterogeneous** residential sales data are used
- **Measures marginal price differences** between homes that vary by the variables of interest, after controlling for other characteristics
- **Controlling characteristics** include square feet, acres, bathrooms, fireplaces, age, condition and scenic vista of the home, location, etc.
- **Variables of interest** include view of turbines, distance from turbines, and development period (e.g. before or after construction began)
- **Results and significance levels** are important

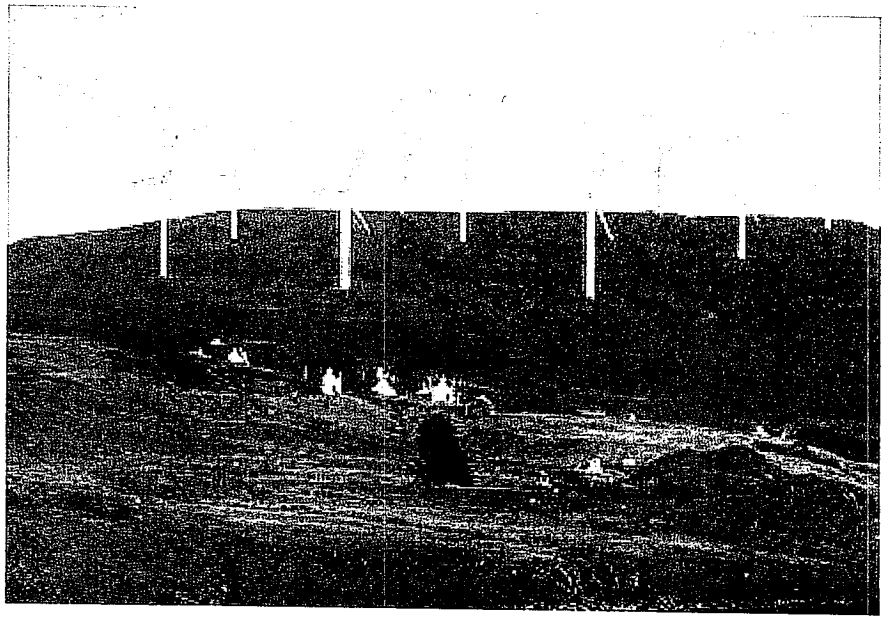
Other Models Used in Analysis

Repeat Sales and Sales Volume Models

To Test for Scenic Vista Stigma, Scenic Vista Itself Is Controlled For

They might pull in two directions…





↑ $

By separating out scenic vista, a potential bias is removed from measurements of the effects of the view of wind turbines

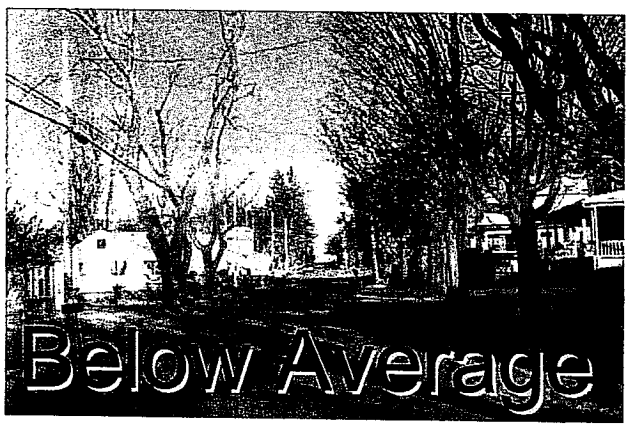
↓ $

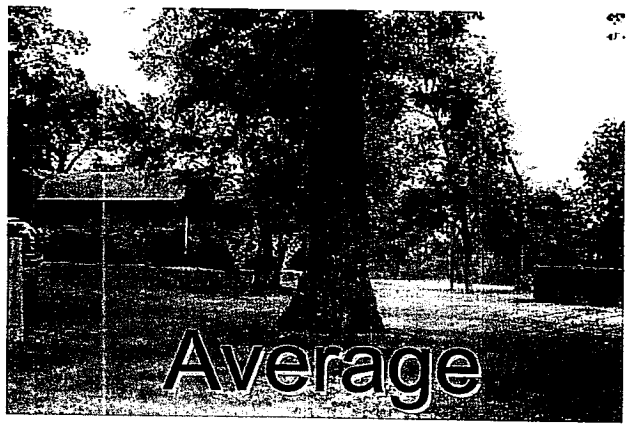
Five Qualitative Ratings Are Used for Quality of Scenic Vista

Each home is given a scenic vista rating, based on field visits











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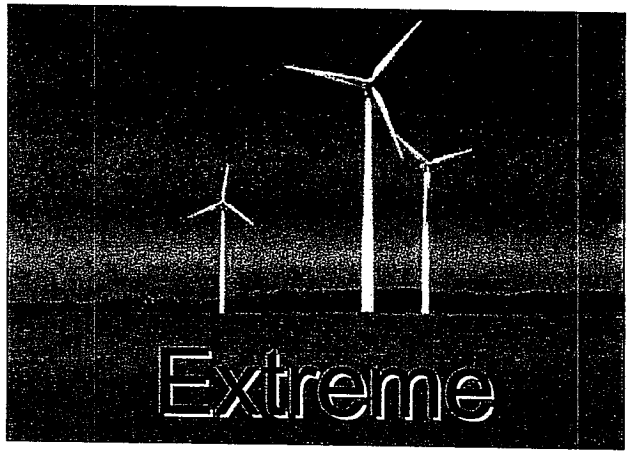
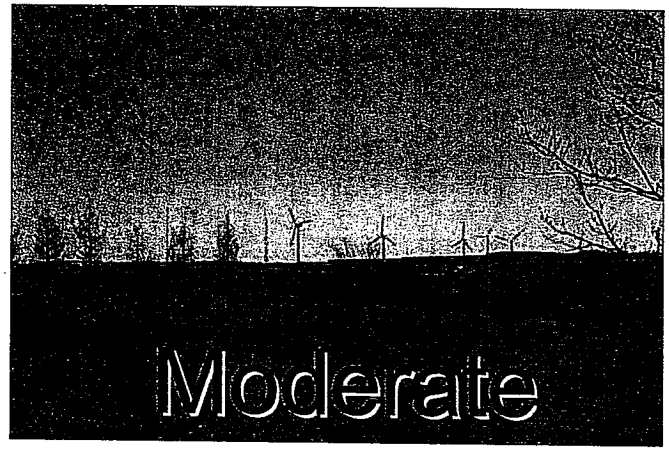
Four Qualitative Ratings Are Used for Dominance of View of Wind Turbines

Each home is given a view of turbines dominance rating, based on field visits









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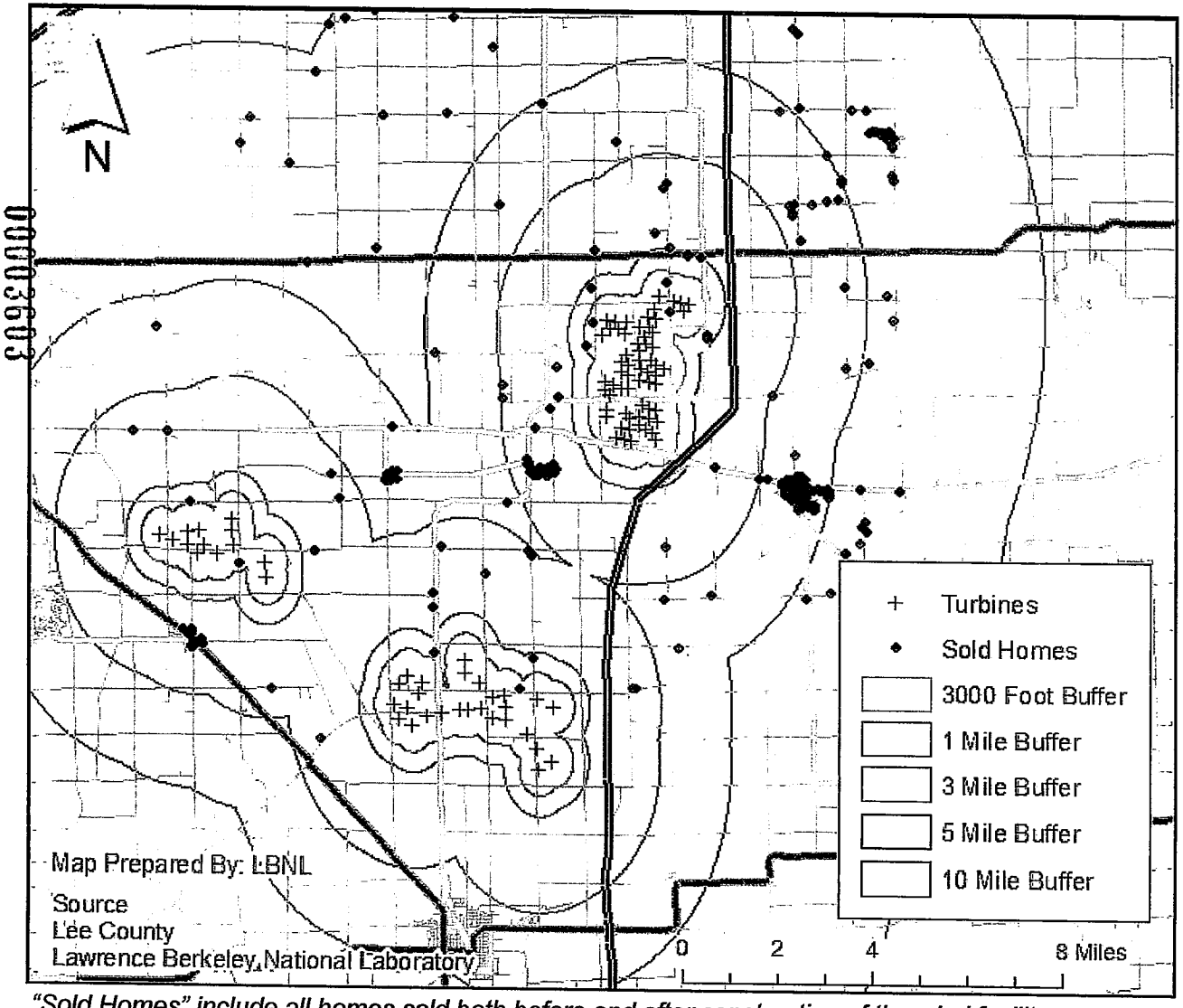
To Test for Area and Nuisance Stigmas,
Distance to Nearest Turbine at Time of Sale Is Determined



"Sold Homes" include all homes sold both before and after construction of the wind facility

Five Distance Bands Are Created

Nuisance Stigma

- Inside of 3000 Feet
- Between 3000 Feet and 1 Mile

Area Stigma

- Between 1 and 3 Miles
- Between 3 and 5 Miles
- Outside of 5 Miles

The Impact of Wind Power Projects on Residential Property Values in the U.S.

- Motivation and Study Methods
  - Motivation
  - Overview and Methods
  - Data Summary
- Summary of Analysis Results
- Conclusions and Further Research

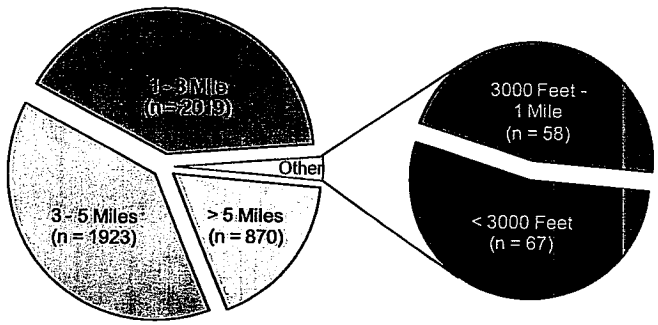
00003604

Data Summary: Development Period, and Distance from and View of Wind Facilities

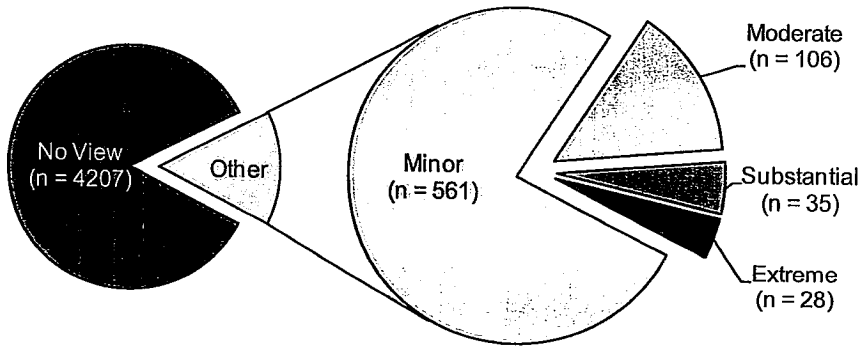
Summary of Transactions across Study Areas and Development Periods

	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Benton/Walla Walla, WA & Umatilla, OR (WAOR)	226	45	76	59	384	**790**
Howard, TX (TXHC)	169	71	113	131	827	**1311**
Custer, OK (OKCC)	484	153	193	187	96	**1113**
Buena Vista, IA (IABV)	152	65	80	70	455	**822**
Lee, IL (ILLC)	115	84	62	71	80	**412**
Kewaunee/Door, WI (WIKCDC)	44	41	68	62	595	**810**
Somerset, PA (PASC)	175	28	46	60	185	**494**
Wayne, PA (PAWC)	223	106	64	71	87	**551**
Madison/Oneida, NY (MYMCOC)	108	9	48	30	268	**463**
Madison, NY (NYMC)	59	165	74	70	325	**693**
TOTAL	**1755**	**767**	**824**	**811**	**3302**	**7459**

Frequency of DISTANCE Ratings for Post-Construction Transactions



Frequency of VIEW Ratings for Post-Construction Transactions



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The Impact of Wind Power Projects on Residential Property Values in the U.S.

- Motivation and Study Methods
- **Summary of Analysis Results**
  - Summary of Results of All Models
  - Key Model Results
    - Base Model - Scenic Vista, Area, and Nuisance Stigma
    - Temporal Aspects Model - Area and Nuisance Stigma
  - Summary of Results of Other Models
- Conclusions and Further Research

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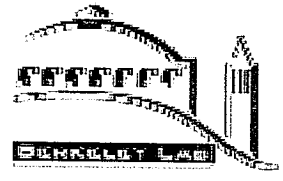

Eight Hedonic Models Used, as Well as Repeat Sales and Sales Volume Analyses

Variety of models used to investigate reliability of "Base Hedonic Model" results and to explore myriad of other potential effects from variety of perspectives

Data across study areas are pooled in this analysis; many other hedonic model specifications, including those with no pooling of data, are investigated

Statistical Model	Description
Base Hedonic Model	Using only "post-construction" transactions (those that occurred after the wind facility was built), this model investigates all three stigmas in a straightforward manner
Alternative Hedonic Models	
View Stability	Using only post-construction transactions, this model investigates whether the Scenic Vista Stigma results from the Base Model are independent of the Nuisance and Area Stigma results
Distance Stability	Using only post-construction transactions, this model investigates whether the Nuisance and Area Stigma results from the Base Model are independent of the Scenic Vista Stigma results
Continuous Distance	Using only post-construction transactions, this model investigates Area and Nuisance Stigmas by applying a continuous distance parameter as opposed to the categorical variables for distance used in the previous models
All Sales	Using all transactions, this model investigates whether the results for the three stigmas change if transactions that occurred before the announcement and construction of the wind facility are included in the sample
Temporal Aspects	Using all transactions, this model further investigates Area and Nuisance Stigmas and how they change for homes that sold more than two years pre-announcement through the period more than four years post-construction
Orientation	Using only post-construction transactions, this model investigates the degree to which a home's orientation to the view of wind turbines affects sales prices
Overlap	Using only post-construction transactions, this model investigates the degree to which the overlap between the view of a wind facility and a home's primary scenic vista affects sales prices
Repeat Sales Model	Using paired transactions of homes that sold once pre-announcement and again post-construction, this model investigates the three stigmas, using as a reference transactions of homes located outside of five miles of the nearest wind turbine and that have no view of the turbines
Sales Volume Model	Using both pre-announcement and post-construction transactions, this model investigates whether the rate of home sales (not the price of those sales) is affected by the presence of nearby wind facilities

Data collection, cleaning, validity, and regression tests are all discussed in detail in the full report

00003607

Each Model Fails to Uncover Conclusive Evidence of Any of the Three Stigmas

Home Prices in Sample Are Not Measurably Impacted by Either the View of or Distance to Wind Facilities

Statistical Model	Is there statistical evidence of: Area Stigma?	Scenic Vista Stigma?	Nuisance Stigma?	Section Reference
Base Model	No	No	No	*Section 4*
View Stability	Not tested	No	Not tested	*Section 5.1*
Distance Stability	No	Not tested	No	*Section 5.1*
Continuous Distance	No	No	No	*Section 5.2*
All Sales	No	No	Limited	*Section 5.3*
Temporal Aspects	No	No	No	*Section 5.4*
Orientation	No	No	No	*Section 5.5*
Overlap	No	Limited	No	*Section 5.6*
Repeat Sales	No	Limited	No	*Section 6*
Sales Volume	No	Not tested	No	*Section 7*

"No"..... No statistical evidence of a negative impact

"Yes"..... Strong statistical evidence of a negative impact

"Limited"..... Limited and inconsistent statistical evidence of a negative impact

"Not tested"..... This model did not test for this stigma

80030008

The Impact of Wind Power Projects on Residential Property Values in the U.S.

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    - Temporal Aspects Model - Area and Nuisance Stigma
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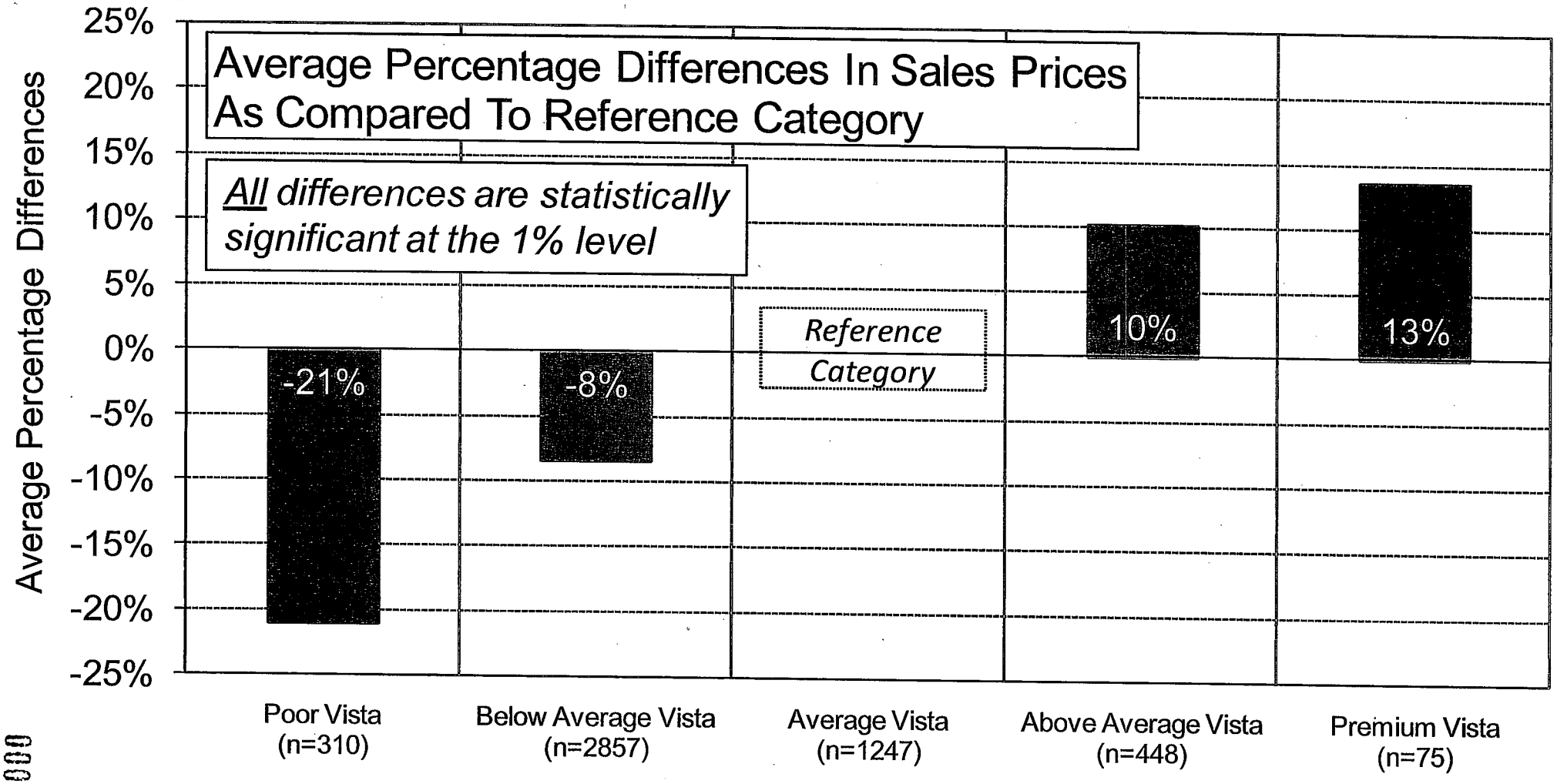
Base Hedonic Model Results:

There Is Strong Statistical Evidence that the Quality of the Scenic Vista Affects Sales Prices



The reference category consists of transactions for homes with an Average Vista, and that occured after construction began on the wind facility

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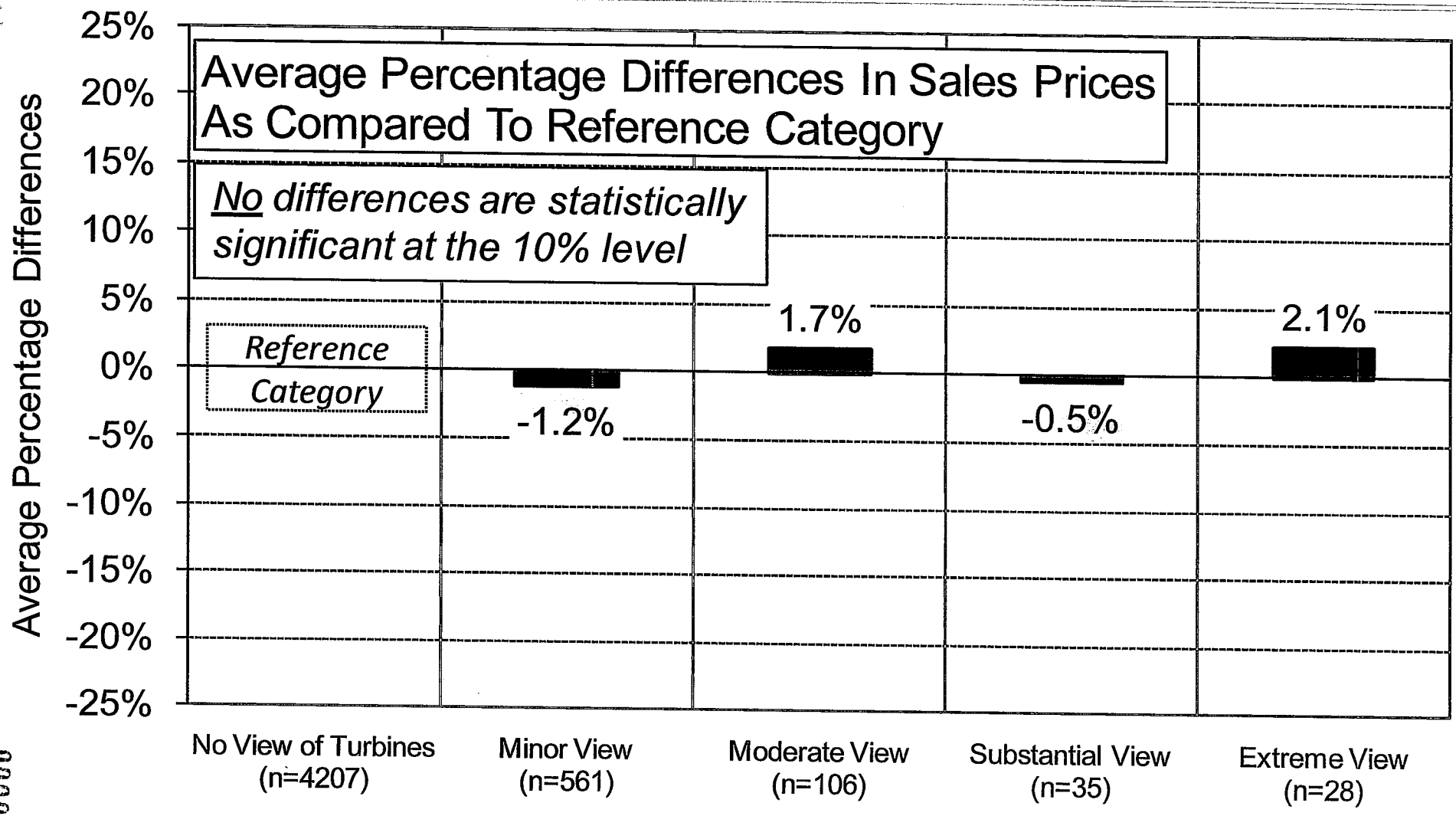
Base Hedonic Model Results:

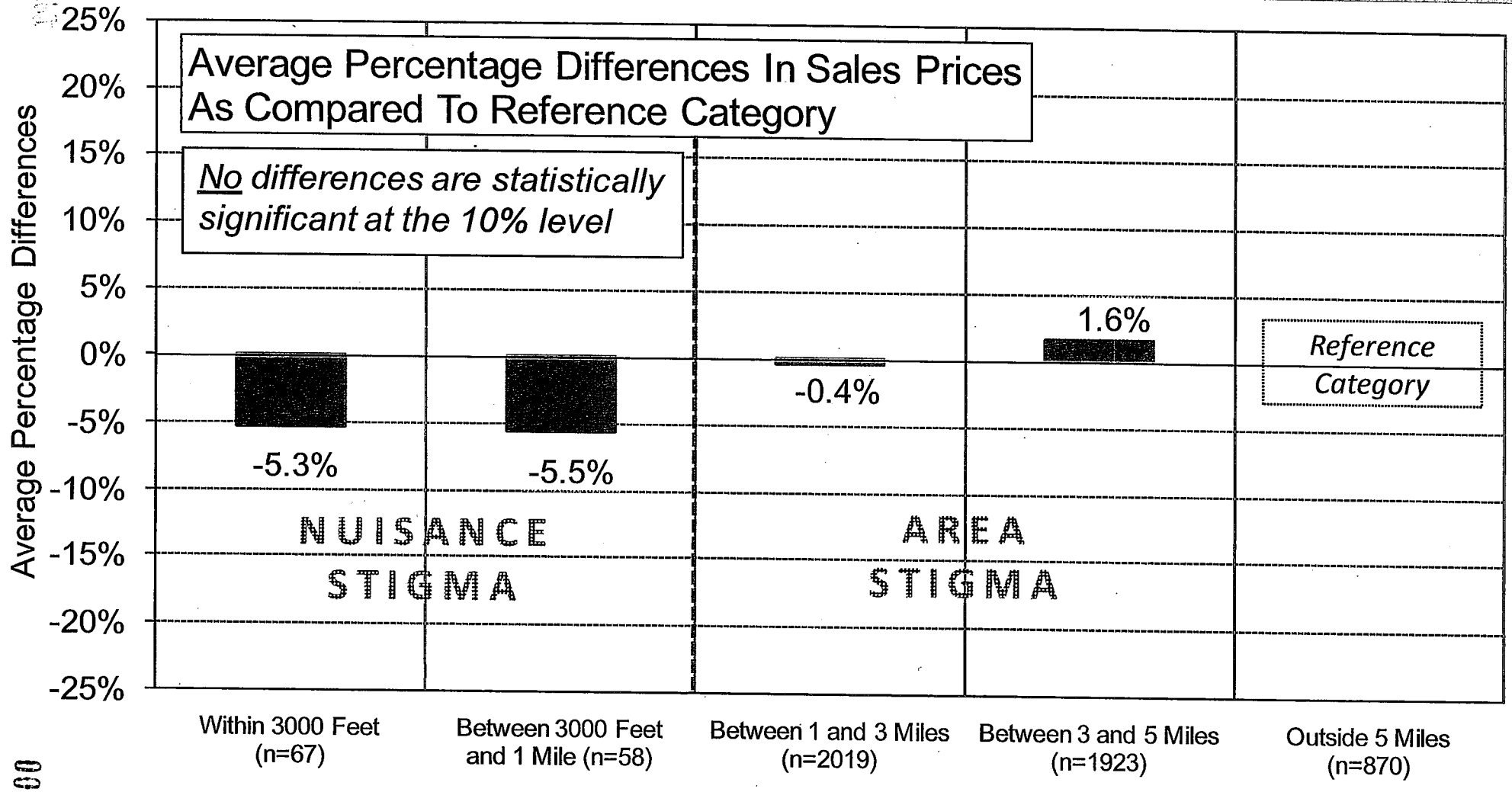
There Is a Lack of Statistical Evidence that the Dominance of the Views of Turbines Affects Sales Prices



The reference category consists of transactions for homes without a view of the turbines, and that occured after construction began on the wind facility

Base Hedonic Model Results:

There Is a Lack of Statistical Evidence that the Distance to the Nearest Turbine Affects Sales Prices



The reference category consists of transactions for homes situated more than five miles from the nearest turbine, and that occured after construction began on the wind facility

The Impact of Wind Power Projects on Residential Property Values in the U.S.

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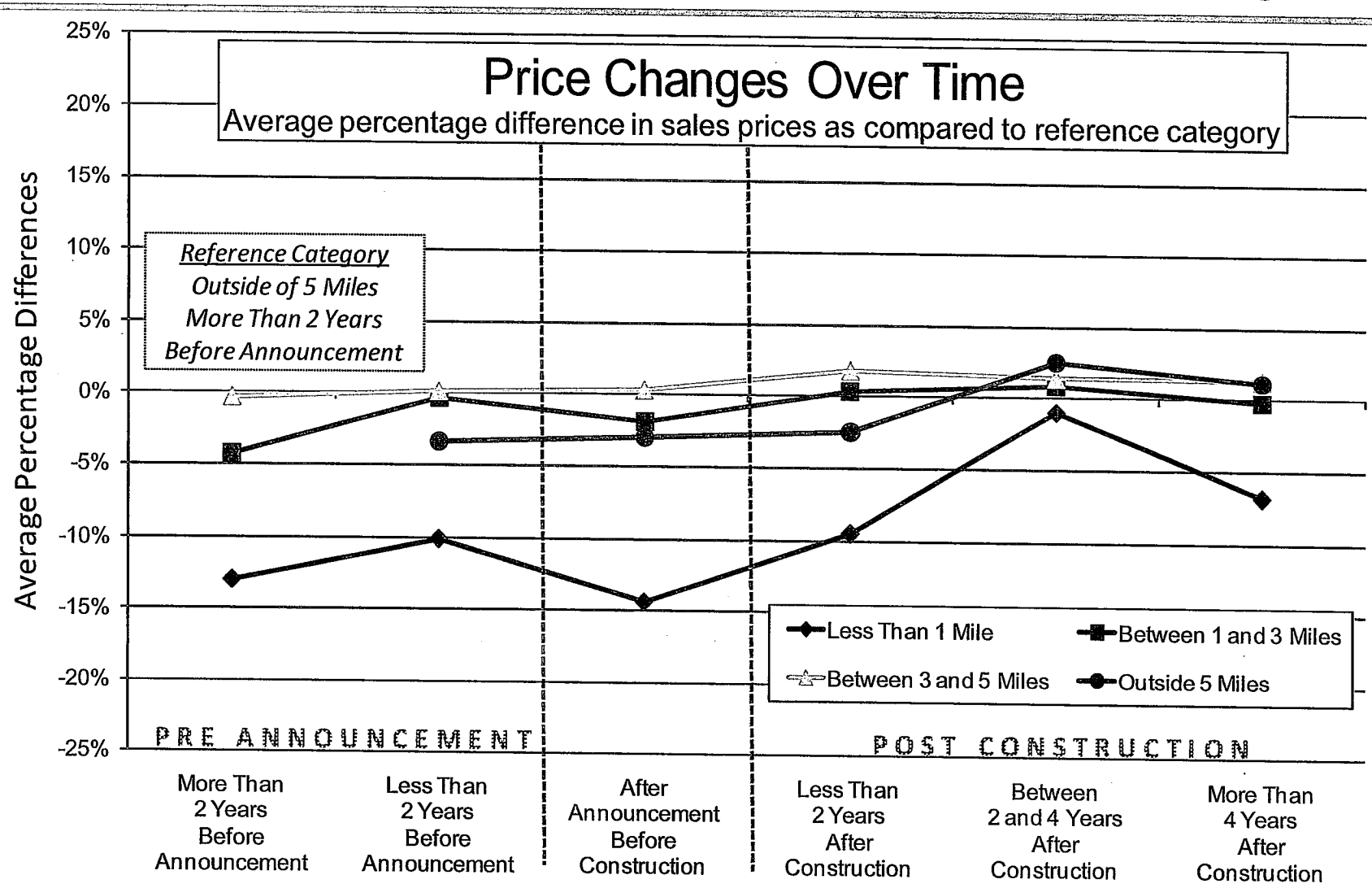
Temporal Aspects Model Results:

Homes Nearest the Turbines Were Depressed in Value Before Construction and Appreciated the Most After Construction While Homes Further Away Were Largely Unchanged Over Time



The reference category consists of transactions of homes situated more than five miles from where the nearest turbine would eventually be located and that occurred more than two years before announcement of the facility

00003614

The Impact of Wind Power Projects on Residential Property Values in the U.S.

- Motivation and Study Methods
- **Summary of Analysis Results**
  - Summary of Results of All Models
  - Key Model Results
    - Base Model - Scenic Vista, Area, and Nuisance Stigma
    - Temporal Aspects Model - Area and Nuisance Stigma
  - **Summary of Results of Other Models**
- Conclusions and Further Research

00003615

Results from Other Models Support Basic Conclusions from Base Hedonic Model

Some examples are…

Repeat Sales Model: Investigated appreciation rates between houses that sold twice with various views of and distances from turbines

Sales Volume Model: Investigated the numbers of homes that sold as a percentage of those that were available to sell at various distances from the turbines

Hedonic Orientation Model: Investigated whether a home's orientation to the view of turbines has an effect on selling price

Hedonic Overlap Model: Investigated whether the degree to which the view of the turbines overlaps the scenic vista has an effect

The results are consistent across all models in that none uncovers conclusive evidence of the existence of any widespread property value impacts for any of the three stigmas

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The Impact of Wind Power Projects on Residential Property Values in the U.S.

- Motivation and Study Methods
- Summary of Analysis Results
- Conclusions and Further Research

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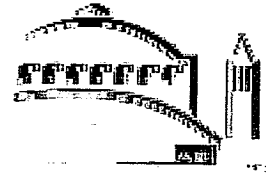

Conclusions

Although the analysis cannot dismiss the possibility that individual homes have been or could be negatively impacted, the Berkeley Lab research finds that if these impacts do exist in the sample of homes analyzed, they are either too small and/or too infrequent to result in any widespread, statistically observable effect

- **Area Stigma:** Homes in the study areas analyzed do not appear to be measurably stigmatized by the arrival of a wind facility
- **Scenic Vista Stigma:** None of the various models finds strong statistical evidence that the view of a nearby wind facility impacts sales prices in a significant and consistent manner
- **Nuisance Stigma:** Homes in the sample that are within a mile of the nearest wind facility, where various nuisance effects have been posited, have not been broadly and measurably affected by the presence of those wind facilities

00003618

Further Research Recommendations

- **Complete "primer"** to summarize findings, place results into broader literature of disamenities, and outline options to measure, mitigate, and manage property value risks
- **Survey homeowners** living close to existing wind facilities especially those who have bought and sold homes in proximity to wind facilities after facility construction
- **Conduct more detailed analysis on sales volume** impacts including time on the market prior to sale
- **Revisit hedonic analysis** when more data are available for homes located particularly close to and having dominating view of wind facilities

00003619



For More Information...

See full report for additional findings, a discussion of the sources of data used, etc.

- **http://eetd.lbl.gov/ea/ems/re-pubs.html**

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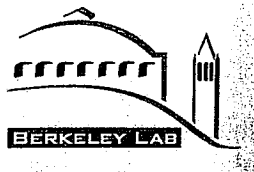
LBNL-2829E



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BERKELEY NATIONAL LABORATORY

The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis

Ben Hoen, Ryan Wiser, Peter Cappers, Mark Thayer, and Gautam Sethi

Environmental Energy Technologies Division

December 2009

Download from http://eetd.lbl.gov/EA/EMP

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LBNL-2829E

The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis

Prepared for the

Office of Energy Efficiency and Renewable Energy
Wind & Hydropower Technologies Program
U.S. Department of Energy
Washington, D.C.

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December 2009

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00003625

Abstract

With wind energy expanding rapidly in the U.S. and abroad, and with an increasing number of communities considering wind power development nearby, there is an urgent need to empirically investigate common community concerns about wind project development. The concern that property values will be adversely affected by wind energy facilities is commonly put forth by stakeholders. Although this concern is not unreasonable, given property value impacts that have been found near high voltage transmission lines and other electric generation facilities, the impacts of wind energy facilities on residential property values had not previously been investigated thoroughly. The present research collected data on almost 7,500 sales of single-family homes situated within 10 miles of 24 existing wind facilities in nine different U.S. states. The conclusions of the study are drawn from eight different hedonic pricing models, as well as both repeat sales and sales volume models. The various analyses are strongly consistent in that none of the models uncovers conclusive evidence of the existence of any widespread property value impacts that might be present in communities surrounding wind energy facilities. Specifically, neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices. Although the analysis cannot dismiss the possibility that individual homes or small numbers of homes have been or could be negatively impacted, it finds that if these impacts do exist, they are either too small and/or too infrequent to result in any widespread, statistically observable impact.

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Executive Summary

Overview

Wind power development in the United States has expanded dramatically in recent years. If that growth is to continue it will require an ever-increasing number of wind power projects to be sited, permitted, and constructed. Most permitting processes in the U.S. require some form of environmental impact assessment as well as public involvement in the siting process. Though public opinion surveys generally show that acceptance towards wind energy is high, a variety of concerns with wind power development are often expressed on the local level during the siting and permitting process. One such concern is the potential impact of wind energy projects on the property values of nearby residences.

Concerns about the possible impact of wind power facilities on residential property values can take many forms, but can be divided into the following non-mutually exclusive categories:

- Area Stigma: A concern that the general area surrounding a wind energy facility will appear more developed, which may adversely affect home values in the local community regardless of whether any individual home has a view of the wind turbines.
- Scenic Vista Stigma: A concern that a home may be devalued because of the view of a wind energy facility, and the potential impact of that view on an otherwise scenic vista.
- Nuisance Stigma: A concern that factors that may occur in close proximity to wind turbines, such as sound and shadow flicker, will have a unique adverse influence on home values.

Although concerns about the possible impact of wind energy facilities on the property values of nearby homes are reasonably well established, the available literature[1] that has sought to quantify the impacts of wind projects on residential property values has a number of shortcomings:

1) Many studies have relied on surveys of homeowners or real estate professionals, rather than trying to quantify real price impacts based on market data;
2) Most studies have relied on simple statistical techniques that have limitations and that can be dramatically influenced by small numbers of sales transactions or survey respondents;
3) Most studies have used small datasets that are concentrated in only one wind project study area, making it difficult to reliably identify impacts that might apply in a variety of areas;
4) Many studies have not reported measurements of the statistical significance of their results, making it difficult to determine if those results are meaningful;
5) Many studies have concentrated on an investigation of the existence of Area Stigma, and have ignored Scenic Vista and/or Nuisance Stigmas;
6) Only a few studies included field visits to homes to determine wind turbine visibility and collect other important information about the home (e.g., the quality of the scenic vista); and
7) Only two studies have been published in peer-reviewed academic journals.

[1] This literature is briefly reviewed in Section 2 of the full report, and includes: Jordal-Jorgensen (1996); Jerabek (2001); Grover (2002); Jerabek (2002); Sterzinger et al. (2003); Beck (2004); Haughton et al. (2004); Khatri (2004); DeLacy (2005); Poletti (2005); Goldman (2006); Hoen (2006); Firestone et al. (2007); Poletti (2007); Sims and Dent (2007); Bond (2008); McCann (2008); Sims et al. (2008); and Kielisch (2009).

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This report builds on the previous literature that has investigated the potential impact of wind projects on residential property values by using a hedonic pricing model and by avoiding many of the shortcomings enumerated above. The hedonic pricing model is one of the most prominent and reliable methods for identifying the marginal impacts of different housing and community characteristics on residential property values (see side bar). This approach dates to the seminal work of Rosen (1974) and Freeman (1979), and much of the available literature that has investigated the impacts of potential disamenities on property values has relied on this method.[2]

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). 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, and 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 a home at a specified point in time), as would be done with an automated valuation model. Instead, the typical goal of a hedonic model is to estimate the marginal contribution of individual house or community characteristics to sales prices.

To seed the hedonic model with appropriate market data, this analysis collects information on a large quantity of residential home sales (i.e., transactions) ($n = 7{,}459$) from ten communities surrounding 24 existing wind power facilities spread across multiple parts of the U.S. (e.g., nine states). Homes included in this sample are located from 800 ft to over five miles from the nearest wind energy facility, and were sold at any point from before wind facility announcement to over four years after the construction of the nearby wind project. Each of the homes that sold was visited to determine the degree to which the wind facility was likely to have been visible at the time of sale and to collect other essential data.

To assess the potential impacts of all three of the property value stigmas described earlier, a base hedonic model is applied as well as seven alternative hedonic models each designed to investigate the reliability of the results and to explore other aspects of the data (see Table ES - 1 below). In addition, a repeat sales model is analyzed, and an investigation of possible impacts on sales volumes is

[2] Many of these studies are summarized in the following reviews: Kroll and Priestley (1992); McCann (1999); Bateman et al. (2001); Boyle and Kiel (2001); Jackson (2001); Simons and Saginor (2006); and Leonard et al. (2008). For further discussion of the hedonic model and its application to the quantification of environmental stigmas see Jackson (2005) and Simons (2006a).

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conducted. Though some limitations to the analysis approach and available data are acknowledged, the resulting product is the most comprehensive and data-rich analysis to date in the U.S. or abroad on the impacts of wind projects on nearby property values.

Analysis Findings

Table ES - 1 describes the ten resulting statistical models that are employed to investigate the effects of wind facilities on residential sales prices, and the specific stigmas that those models investigate. Though all models test some combination of the three possible stigmas, they do so in different ways. For instance, the Base Model asks the question, "All else being equal, do homes near wind facilities sell for prices different than for homes located farther away?", while the All Sales Model asks, "All else being equal, do homes near wind facilities that sell after the construction of the wind facility sell for prices different from similar homes that sold before the announcement and construction of the facility?" Each model is therefore designed to not only test for the reliability of the overall results, but also to explore the myriad of potential effects from a variety of perspectives. Table ES-2 summarizes the results from these models.

Table ES - 1: Description of Statistical Models

Statistical Model	Description
Base Hedonic Model	Using only "post-construction" transactions (those that occurred after the wind facility was built), this model investigates all three stigmas in a straightforward manner
Alternative Hedonic Models	
View Stability	Using only post-construction transactions, this model investigates whether the Scenic Vista Stigma results from the Base Model are independent of the Nuisance and Area Stigma results
Distance Stability	Using only post-construction transactions, this model investigates whether the Nuisance and Area Stigma results from the Base Model are independent of the Scenic Vista Stigma results
Continuous Distance	Using only post-construction transactions, this model investigates Area and Nuisance Stigmas by applying a continuous distance parameter as opposed to the categorical variables for distance used in the previous models
All Sales	Using all transactions, this model investigates whether the results for the three stigmas change if transactions that occurred before the announcement and construction of the wind facility are included in the sample
Temporal Aspects	Using all transactions, this model further investigates Area and Nuisance Stigmas and how they change for homes that sold more than two years pre-announcement through the period more than four years post-construction
Orientation	Using only post-construction transactions, this model investigates the degree to which a home's orientation to the view of wind turbines affects sales prices
Overlap	Using only post-construction transactions, this model investigates the degree to which the overlap between the view of a wind facility and a home's primary scenic vista affects sales prices
Repeat Sales Model	Using paired transactions of homes that sold once pre-announcement and again post-construction, this model investigates the three stigmas, using as a reference transactions of homes located outside of five miles of the nearest wind turbine and that have no view of the turbines
Sales Volume Model	Using both pre-announcement and post-construction transactions, this model investigates whether the rate of home sales (not the price of those sales) is affected by the presence of nearby wind facilities

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Table ES-2: Impact of Wind Projects on Property Values: Summary of Key Results

Statistical Model	Is there statistical evidence of: Area Stigma?	Scenic Vista Stigma?	Nuisance Stigma?	Section Reference
Base Model	No	No	No	*Section 4*
View Stability	Not tested	No	Not tested	*Section 5.1*
Distance Stability	No	Not tested	No	*Section 5.1*
Continuous Distance	No	No	No	*Section 5.2*
All Sales	No	No	Limited	*Section 5.3*
Temporal Aspects	No	No	No	*Section 5.4*
Orientation	No	No	No	*Section 5.5*
Overlap	No	Limited	No	*Section 5.6*
Repeat Sales	No	Limited	No	*Section 6*
Sales Volume	No	Not tested	No	*Section 7*

"No"..... No statistical evidence of a negative impact
"Yes"..... Strong statistical evidence of a negative impact
"Limited"..... Limited and inconsistent statistical evidence of a negative impact
"Not tested"..... This model did not test for this stigma

Base Model Results

The Base Model serves as the primary model and allows all three stigmas to be explored. In sum, this model finds no persuasive evidence of any of the three potential stigmas: neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices.

- Area Stigma: To investigate Area Stigma, the model tests whether the sales prices of homes situated anywhere outside of one mile and inside of five miles of the nearest wind facility are measurably different from the sales price of those homes located outside of five miles. No statistically significant differences in sales prices between these homes are found (see Figure ES-1).
- Scenic Vista Stigma: For Scenic Vista Stigma, the model is first used to investigate whether the sales prices of homes with varying scenic vistas - absent the presence of the wind facility - are measurably different. The model results show dramatic and statistically significant differences in this instance (see Figure ES-2); not surprisingly, home buyers and sellers consider the scenic vista of a home when establishing the appropriate sales price. Nonetheless, when the model tests for whether homes with minor, moderate, substantial, or extreme views of wind turbines have measurably different sales prices, no statistically significant differences are apparent (see Figure ES-3).
- Nuisance Stigma: Finally, for Nuisance Stigma, the model is used to test whether the sales prices of homes situated inside of one mile of the nearest wind energy facility are measurably different from those homes located outside of five miles. Although sample size is somewhat limited in this case,[3] the model again finds no persuasive statistical evidence that wind

[3] 125 homes were located inside of one mile of the nearest wind facility and sold post-construction.

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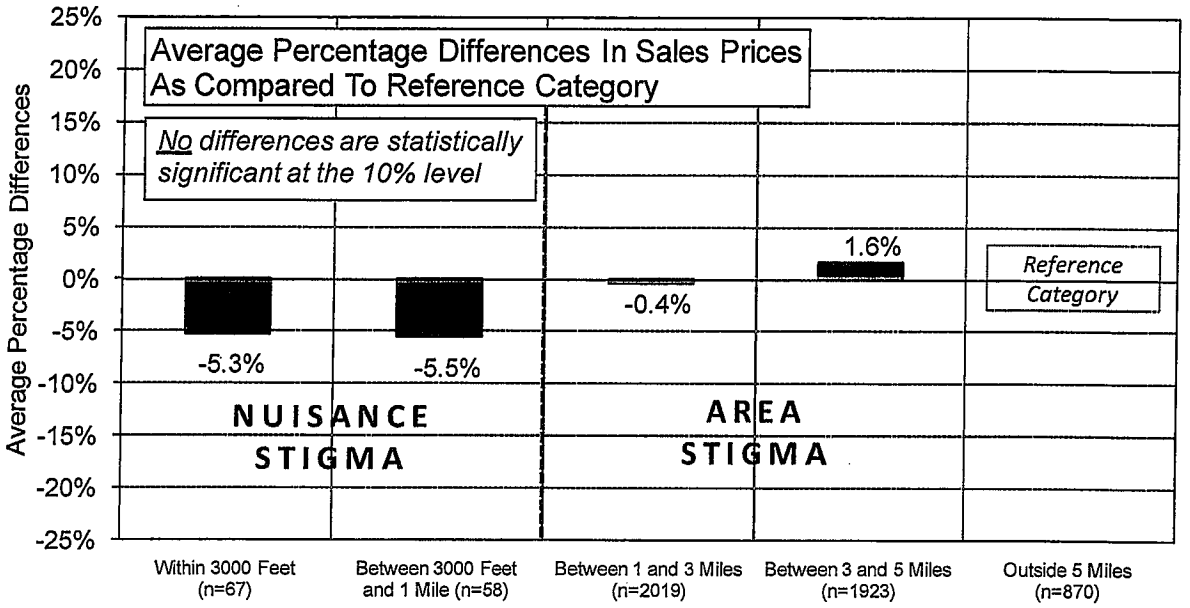
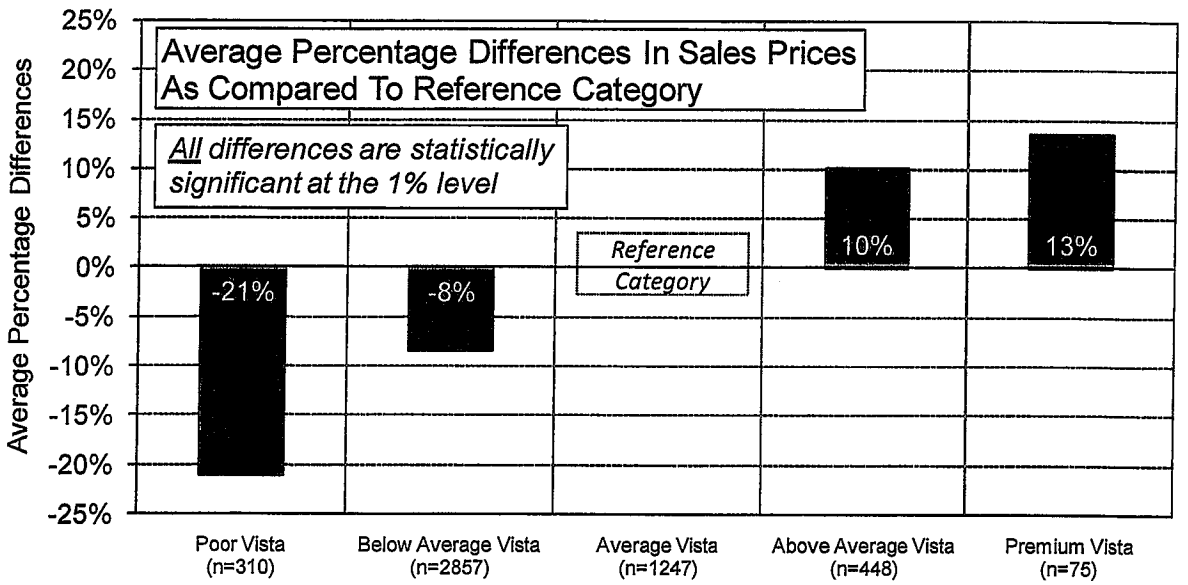
facilities measurably and broadly impact residential sales prices (see Figure ES-1 and later results).

Figure ES-1: Base Model Results: Area and Nuisance Stigma



The reference category consists of transactions for homes situated more than five miles from the nearest turbine, and that occured after construction began on the wind facility

Figure ES-2: Base Model Results: Scenic Vista



The reference category consists of transactions for homes with an Average Vista, and that occured after construction began on the wind facility

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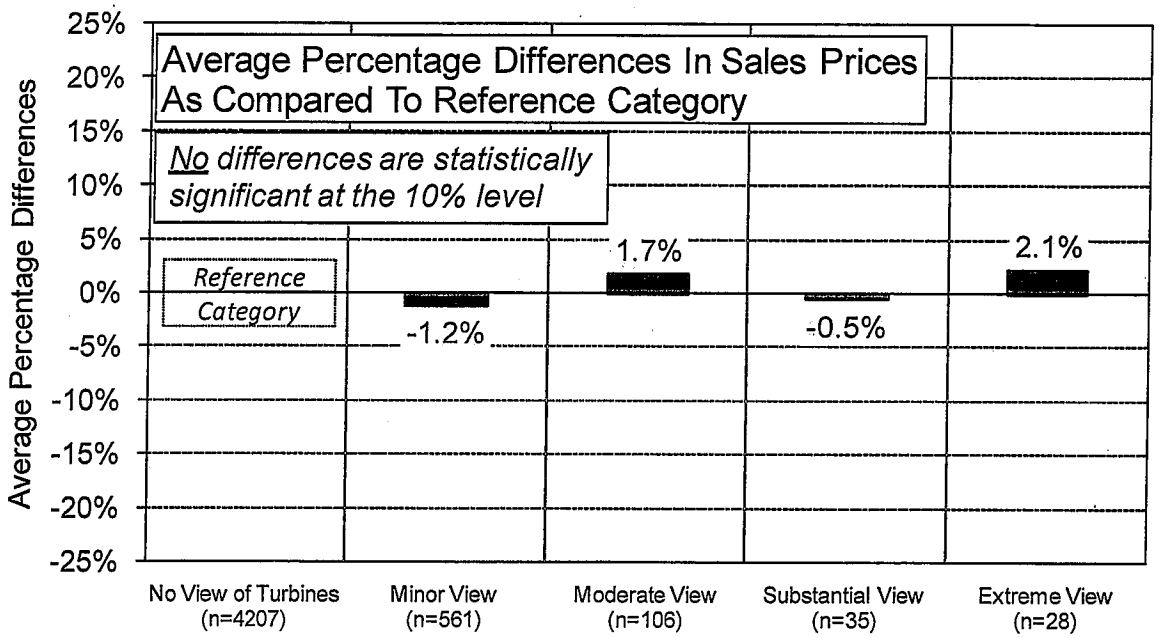
Figure ES-3: Base Model Results: Scenic Vista Stigma



The reference category consists of transactions for homes without a view of the turbines, and that occured after construction began on the wind facility

The seven alternative hedonic models and the additional analysis contained in the Repeat Sales and Sales Volume Models (see Table ES-2) provide a fuller picture of the three stigmas and the robustness of the Base Model results.

Area Stigma: Other Model Results

Concentrating first on Area Stigma, the results from all of the models are similar: there is no statistical evidence of a widespread Area Stigma among the homes in this sample. Homes in the study areas analyzed here do not appear to be measurably stigmatized by the arrival of a wind facility, regardless of when those homes sold in the wind project development process and regardless of whether the homes are located one mile or five miles away from the nearest facility.

In the All Sales Model, for example, after adjusting for inflation,[4] homes that sold after wind facility construction and that had no view of the turbines are found to have transacted for higher prices - not lower - than those homes that sold prior to wind facility construction. Moreover, in the Temporal Aspects Model, homes that sold more than two years prior to the announcement of the wind facility and that were located more than five miles from where the turbines were eventually located are found to have transacted for lower prices - not higher - than homes situated closer to the turbines and that sold at any time after the announcement and construction of the wind facility (see Figure ES - 4). Further, in the Repeat Sales Model, homes located near the wind facilities that transacted more than once were found to have appreciated between those sales by an amount that was no different from that experienced by homes located in an area

[4] All sales prices in all models are adjusted for inflation, but because this model (and the Temporal Aspects Model) deals with time explicitly, it is mentioned specifically here.

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many miles away from the wind facilities. Finally, as shown in Table ES-2, none of the other models identified evidence of a broadly negative and statistically significant Area Stigma.

Scenic Vista Stigma: Other Model Results

With respect to Scenic Vista Stigma, the seven alternative hedonic models and the additional analysis contained in the Repeat Sales Model find little consistent evidence of a broadly negative and statistically significant impact. Although there are 730 residential transactions in the sample that involve homes that had views of a wind facility at the time of sale, 160 of which had relatively significant views (i.e., a rating higher than Minor), none of the various models finds strong statistical evidence that the view of a nearby wind facility impacts sales prices in a significant and consistent manner.

When concentrating only on the view of the wind facilities from a home (and not testing for Area and Nuisance Stigmas simultaneously), for example, the results from the View Stability Model are very similar to those derived from the Base Model, with no evidence of a Scenic Vista Stigma. Similarly, the All Sales Model finds that homes that sold after wind facility construction and that had a view of the facility transacted for prices that are statistically indistinguishable from those homes that sold at any time prior to wind facility construction. The Orientation Model, meanwhile, fails to detect any difference between the sales prices of homes that had either a front, back, or side orientation to the view of the wind facility. As shown in Table ES-2, the Continuous Distance and Temporal Aspects models also do not uncover any evidence of a broadly negative and statistically significant Scenic Vista Stigma.

In the Repeat Sales Model, some limited evidence is found that a Scenic Vista Stigma may exist, but those effects are weak, fairly small, somewhat counter-intuitive, and are at odds with the results of other models. This finding is likely driven by the small number of sales pairs that are located within one mile of the wind turbines and that experience a dramatic view of those turbines. Finally, in the Overlap Model, where the degree to which a view of the wind facility overlaps the primary scenic vista from the home is accounted for, no statistically significant differences in sales prices are detected between homes with somewhat or strongly overlapping views when compared to those homes with wind turbine views that did not overlap the primary scenic vista. Though this model produces some weak evidence of a Scenic Vista Stigma among homes with Minor views of wind facilities, the same model finds that the sales prices of those homes with views that barely overlap the primary scenic vista are positively impacted by the presence of the wind facility. When these two results are combined, the overall impact is negligible, again demonstrating no persuasive evidence of a Scenic Vista Stigma.

Nuisance Stigma: Other Model Results

Results for Nuisance Stigma from the seven alternative hedonic models and the additional analysis contained in the Repeat Sales and Sales Volume Models support the Base Model results. Taken together, these models present a consistent set of results: homes in this sample that are within a mile of the nearest wind facility, where various nuisance effects have been posited, have not been broadly and measurably affected by the presence of those wind facilities. These results imply that Nuisance Stigma effects are either not present in this sample, or are too small and/or infrequent to be statistically distinguished.

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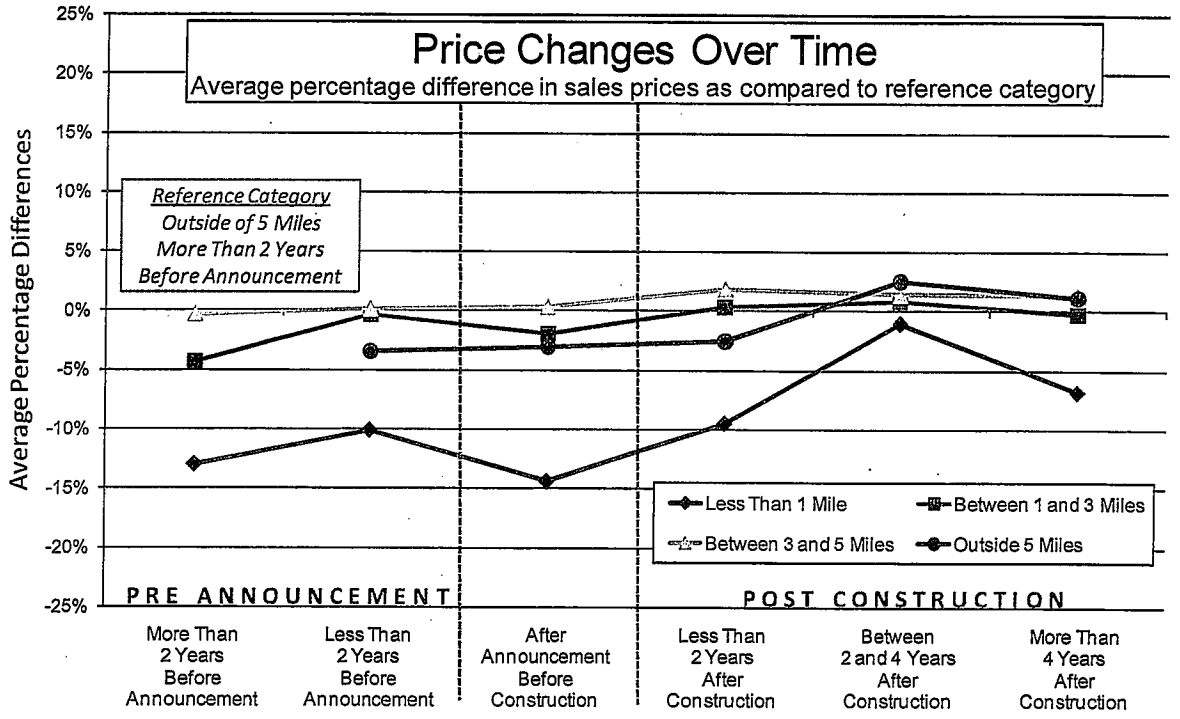
In the Distance Stability Model, for example, when concentrating only on the distance from homes to the nearest wind turbine (and not testing for Scenic Vista Stigma simultaneously), the results are very similar to those derived from the Base Model, with no statistical evidence of a Nuisance Stigma. These results are corroborated by the Continuous Distance, Orientation, Overlap, and Repeat Sales Models, none of which find a statistically significant relationship between distance and either sales prices or appreciation rates. Relatedly, the Sales Volume analysis finds no evidence that homes located within one mile of the nearest wind turbine are sold any more or less frequently than homes located farther away from the wind facilities.

In the All Sales Model, a weakly significant difference is found between the sales prices of homes located between 3000 feet and one mile of the nearest wind facility and the homes that sold before the announcement of the wind facility. This effect, however, is largely explained by the results of the Temporal Aspects Model, shown in Figure ES - 4. The Temporal Aspects Model finds that homes located within one mile of where the wind turbines would eventually be located sold for depressed prices well before the wind facility was even announced or constructed. In all time periods following the commencement of wind facility construction, however, inflation-adjusted sales prices increased - not decreased - relative to pre-announcement levels, demonstrating no statistical evidence of a Nuisance Stigma. The results from the All Sales Model (and, for that matter, the negative, albeit statistically insignificant coefficients inside of one mile in the Base Model, see Figure ES-1) are therefore an indication of sales price levels that preceded wind facility announcement construction, and that are not sustained after construction.

Figure ES - 4: Temporal Aspects Model Results: Area and Nuisance Stigma



The reference category consists of transactions of homes situated more than five miles from where the nearest turbine would eventually be located and that occurred more than two years before announcement of the facility

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Conclusions and Further Research Needs

Though each of the analysis techniques used in this report has strengths and weaknesses, the results as a whole are strongly consistent in that none of the models uncovers conclusive evidence of the presence of any of the three property value stigmas that might be present in communities surrounding wind power facilities. Therefore, based on the data sample and analysis presented here, no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities. Although the analysis cannot dismiss the possibility that individual homes or small numbers of homes have been or could be negatively impacted, it finds that if these impacts do exist, they are either too small and/or too infrequent to result in any widespread, statistically observable impact. Moreover, to the degree that homes and wind facilities in this sample are similar to homes and facilities in other areas of the United States, the results presented here are expected to be transferable to other areas.

This work builds on the existing literature in a number of respects, but there remain a number of areas for further research. The primary goal of subsequent research should be to concentrate on those homes located closest to wind facilities, where the data sample herein was the most limited. Additional research of the nature reported in this paper could be pursued, but with a greater number of transactions, especially for homes particularly close to wind facilities. A more detailed analysis of sales volume impacts may also be fruitful, as would an assessment of the potential impact of wind facilities on the length of time homes are on the market in advance of an eventual sale. Finally, it would be useful to conduct a survey of those homeowners living close to existing wind facilities, and especially those residents who have bought and sold homes in proximity to wind facilities after facility construction, to assess their opinions on the impacts of wind project development on their home purchase and sales decisions.

00003640

1. Introduction

Wind power development has expanded dramatically in recent years (GWEC, 2009). Although the percent of electricity supplied to the U.S. and globally from wind power projects installed through 2008 remains relatively low (1.9% and 1.5%, respectively) (Wiser and Bolinger, 2009), there are expectations that those percentages will rise and that wind energy could contribute a significant percentage of future electricity supply (GWEC, 2008; Wiser and Hand, 2010). Most recently, President Obama, in his 2009 State of the Union address, called for a doubling of renewable energy in three years (by 2012), and in 2008 the U.S. Department of Energy produced a report that analyzed the feasibility of meeting 20% of U.S. electricity demand with wind energy by 2030 (US DOE, 2008).

To meet these goals, a significant amount of wind project development activity would be required. The average size of wind power projects built in the U.S. in 2007 and 2008 was approximately 100 MW (Wiser and Bolinger, 2009) and the total amount of capacity required to reach 20% wind electricity is roughly 300,000 MW (US DOE, 2008). Therefore, to achieve 20% wind electricity by 2030, a total of 3,000 wind facilities may need to be sited and permitted. Most permitting processes in the U.S. require some form of environmental impact assessment, and some form of public involvement in the siting process. Though surveys show that public acceptance is high in general for wind energy (e.g., Wolsink, 2000; Firestone and Kempton, 2006), a variety of concerns are often expressed on the local level that can impact the length and outcome of the siting and permitting process. These concerns range from the potential impacts of wind projects on wildlife habitat and mortality, radar and communications systems, ground transportation and historic and cultural resources, to aesthetic and property value concerns as well as potential nuisance and health impacts. As a result, a variety of siting and permitting guidelines (AWEA, 2008) and impact assessments (NAS, 2007) have been completed.

Surveys of local communities considering wind facilities have consistently ranked adverse impacts on aesthetics and property values in the top tier of concerns (e.g., BBC R&C, 2005; Firestone and Kempton, 2006). Developers of wind energy echo this assessment: they ranked aesthetics and property values as two of the top concerns (first and third respectively) for individuals or communities opposed to wind power development (Paul, 2006). Local residents have even brought suit against a developer over property values (Dale Rankin v. FPL, 2008), and some developers have responded to these concerns by offering "neighbor agreements" that compensate nearby homeowners for the potential impacts of wind projects.

The two concerns of aesthetics and property values are intrinsically linked. It is well established that a home's value will be increased if a high-quality scenic vista is enjoyed from the property (e.g., Seiler et al., 2001). Alternatively, it is reasonable to assume that if a home's scenic vista overlaps with a view of a disamenity, the home might be devalued, as has been found for high-voltage transmission lines (HVTL) (Kroll and Priestley, 1992; Des-Rosiers, 2002). Whether a view of wind turbines similarly impacts home values is a key topic of debate in local siting decisions. Aesthetics alone, however, is not the only pathway through which wind projects might impact residential property values. Distance to the nearest wind turbine, for example, might also have an impact if various nuisance effects are prominent, such as turbine noise,

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shadow flicker,[5] health or safety concerns, or other impacts, real or perceived. In this way, property values near wind turbines might be impacted in the same way as homes near roads might be devalued (Bateman et al., 2001). Additionally, there is evidence that proximity to a disamenity, even if that disamenity is not visible and is not so close as to have obvious nuisance effects, may still decrease a home's sales price, as has been found to be the case for landfills (Thayer et al., 1992).

Taken together, these general concerns about the possible impacts of wind projects on residential property values can be loosely categorized into three potential stigmas:

- Area Stigma: A concern that the general area surrounding a wind energy facility will appear more developed, which may adversely affect home values in the local community regardless of whether any individual home has a view of the wind turbines.
- Scenic Vista Stigma: A concern that a home may be devalued because of the view of a wind energy facility, and the potential impact of that view on an otherwise scenic vista.
- Nuisance Stigma: A concern that factors that may occur in close proximity to wind turbines, such as sound and shadow flicker, will have a unique adverse influence on home values.

These three potential stigmas are not mutually exclusive and could, in theory, be present in part or in combination for any single home. Consequently, all three potential impacts must be considered when analyzing the effects of wind facilities on residential sales prices.

Although concerns about the potential impact of wind projects on residential property values are often mentioned in siting cases, the state of the existing literature on this topic leaves much to be desired. To some extent, the growing body of research investigating this topic has come to opposing conclusions. The most recent and comprehensive of these studies have often concluded that no widespread impacts of wind projects on residential property values are apparent (Hoen, 2006; Sims and Dent, 2007; Sims et al., 2008). At the same time, pre-construction surveys of both homeowners and real estate experts have sometimes found an expectation of negative impacts (e.g. Haughton et al., 2004), and post-construction appraisals have sometimes come to similar conclusions (McCann, 2008; Kielisch, 2009). Given the state of the literature, it is not uncommon for local siting and permitting processes to involve contradicting testimony from experts, as occurred in 2004 when the Public Service Commission of Wisconsin heard opposing conclusions from two studies conducted by experienced home valuation experts (Poletti, 2005; Zarem, 2005).

This report contains the most comprehensive and data-rich analysis to date on the potential impacts of wind projects on nearby residential sales prices. Data from 7,459 residential transactions were collected from the surrounding communities of 24 individual wind projects in nine states and 14 counties in the United States.[6] Because of the large sample size, the diversity of wind projects included in the analysis, and the depth of information collected, a number of different analyses were possible. Specifically, this report relies heavily on a hedonic regression

[5] Shadow flicker occurs when the sun shines through the wind turbine blades when at a low angle to the horizon and shadows are cast on a window or interior wall of a residence (NAS, 2007).

[6] The majority of the analysis only includes homes that sold after wind facility construction began, totaling 4,937 transactions.

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model[7] and uses various forms of that model to investigate potential effects and to confirm the robustness of the resulting findings. To further investigate the robustness of the results, a repeat sales model[8] and a sales volume model[9] are also utilized. In sum, this work builds and improves on the previous literature, and provides an in-depth assessment of the question of whether residential property values in the United States have been affected, in a statistically measurable way, by views of and proximity to wind power facilities.

The remainder of this report is structured as follows. The next section discusses the hedonic model in general, its application to environmental disamenities research, and some potentially analogous results drawn from these studies. This is followed by a summary of the existing literature that has investigated the effects of wind energy on residential property values. The report then turns to the data used in the analysis, a discussion of the primary (or "base") hedonic model, and an analysis of the results from that statistical model. Following that, a set of alternative hedonic models are estimated, as well as a repeat sales model and sales volume model, to test for the robustness of the "base" model results and to explore other aspects of the data. Taking into account the full set of results presented earlier, the report then discusses the three stigmas that may lead to wind projects impacting residential property values, and summarizes how the analysis informs the existence and magnitude of these potential effects. The report ends with a brief conclusion, and a discussion of future research possibilities. A number of appendices follow the conclusion, and contain detailed information on each wind project study area, the data collection instrument and qualitative rating systems used in the field research, the investigation of the best "base" model, the hedonic model assumptions and related tests, and full results from all of the additional statistical models estimated in the report.

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[7] The hedonic regression model, which was briefly described in a sidebar in the Executive Summary, is described in detail in Section 2.1.

[8] A repeat sales model uses, as its dataset, only those homes that have sold more than once. By comparing annual appreciation rates of homes that sold once before facility announcement, and again after construction, it can be tested, in an alternative fashion, if home values are affected by the distance to or view of nearby wind turbines.

[9] Sales volume can be defined as the percentage of homes that fit a certain criteria (e.g. single family, on less than 25 acres, zoned residential, assessed for more than $10,000) that actually did sell. By comparing sales volumes at various distances to wind facilities, before and after the facility was built, a further robustness test is possible.

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2. Previous Research

Hedonic pricing models are frequently used to assess the marginal impacts of house and community characteristics on sales prices and by extension on property values in general. Because the hedonic model is the primary statistical method used in this report, this section begins by describing the model in more detail and providing some relevant examples of its use. The section then reviews the existing literature on the effects of wind energy facilities on surrounding property values, highlights the shortcomings of that literature, and outlines how the present research addresses those shortcomings.

2.1. Hedonic Models and Environmental Disamenities

A house can be thought of as a bundle of characteristics (e.g., number of square feet, number of bathrooms, number of fireplaces, and amount of acreage). When a price is agreed upon between a buyer and seller there is an implicit understanding that those characteristics have value. When data from a number of sales transactions are available, the individual marginal contribution to the sales price of each characteristic can be estimated with a hedonic regression model (Rosen, 1974; Freeman, 1979). This relationship takes the basic form:

Sales price = f(house structural characteristics, other factors)

where "house structural characteristics" might include, but are not limited to, the number of square feet of living area, bathrooms, and fireplaces, the presence of central AC and the condition of the home, and "other factors" might include, but are not limited to, home site characteristics (e.g., number of acres), neighborhood characteristics (e.g., school district), market conditions at the time of sale (e.g., prevailing mortgage interest rates), and surrounding environmental conditions (e.g., proximity to a disamenity or amenity).

The relationship between the sales price of homes and the house characteristics and other factors can take various forms. The most common functional form is the semi-log construction where the dependent variable is the natural log of the inflation adjusted sales price, and the independent variables are unadjusted (not transformed) home characteristics and other factors. The usefulness of this form of hedonic model is well established (Malpezzi, 2003; Sirmans et al., 2005b; Simons and Saginor, 2006) assuming that certain threshold assumptions are met.[10] The model is used commonly by academics, real estate assessors, appraisers, and realtors when large datasets are available on past residential sales transactions, and when estimates of the marginal impact of certain house characteristics and other factors on sales prices are desired.[11]

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[10] These assumptions, which are discussed in greater detail in Section 4.2 and Appendix G, include absence of outliers and/or influencers, presence of homoskedastic variances, absence of spatial and temporal autocorrelation, and absence of collinearity between the variables of interest and other independent variables.

[11] It should be emphasized that a hedonic model is not designed to appraise properties (i.e., to establish an estimate of the market value of a home at a specified point in time), as would be done with an automated valuation model (AVM). Rather, hedonic models are designed to estimate the marginal contribution of individual house or community characteristics to sales prices, which requires hedonic models to rely upon large data sets with a sizable number of explanatory variables. Appraisal models, on the other hand, are generally based on small, localized data sets (i.e., "comps") and a limited number of explanatory variables that pertain to nearby properties. Due to their higher level of accuracy through the use of significantly more information (e.g., diverse spatial, temporal, and

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A particularly useful application of the hedonic regression 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 (e.g., Mahan et al., 2000) or lake views (e.g., Seiler et al., 2001), and disamenities, such as proximity to and/or views of high-voltage transmission lines (HVTLs) (e.g. Des-Rosiers, 2002), fossil fuel power plants (Davis, 2008), roads (e.g. Bateman et al., 2001), cell phone towers (e.g. Bond and Wang, 2007), and landfills (e.g., Thayer et al., 1992; Ready and Abdalla, 2005).

There are a number of useful reviews that describe the application of hedonic models in these circumstances (Kroll and Priestley, 1992; Farber, 1998; McCann, 1999; Bateman et al., 2001; Boyle and Kiel, 2001; Jackson, 2001; Ready and Abdalla, 2005; Simons and Saginor, 2006; Simons, 2006b; Leonard et al., 2008).[12] The large number of studies covered in these reviews demonstrate that hedonic models are regularly used to investigate the interplay between home values and distance to potential disamenities, teasing out if and how sales prices are adversely affected depending on the distance of a typical home from a disamenity. For example, Carroll et al. (1996) use a hedonic model to estimate a devaluation of 16% for homes "close to" a chemical plant, with a 6.5% increase in sales price per mile away out to 2.5 miles, at which point effects fade entirely. Dale et al. (1999) find a maximum effect of -4% near a lead smelter, with sales prices increasing 2% for each mile away out to two miles, where effects again fade. Ready and Abdalla (2005) find maximum effects near landfills of -12.4%, which fade entirely outside 2,400 feet, and maximum effects near confined animal feeding operations of -6.4%, which fade entirely outside of 1,600 feet. Meanwhile, studies of other energy infrastructure, such as HVTLs, find maximum effects of -5.7% for homes adjacent to a HVTL tower, and an increase in prices of 0.018% per foot away from the tower out to 300 feet (Hamilton and Schwann, 1995), and maximum effects of -14% for homes within 50 feet of a HVTL, but no effect for similar homes at 150 feet (Des-Rosiers, 2002). Further, for fossil fuel power plants, Davis (2008) finds average adverse effects of between 3 and 5% inside of two miles but that those effects fade entirely outside of that distance range.

In addition to investigating how sales prices change with distance to a disamenity, hedonic models have been used to investigate how prices have changed over time. For instance, sales prices have sometimes been found to rebound after the removal of a disamenity, such as a lead smelter (Dale et al., 1999), or to fade over time, as with HVTLs (Kroll and Priestley, 1992) or spent fuel storage facilities (Clark and Allison, 1999). Finally, hedonic models have been used to estimate how views of a disamenity affect sales prices. Des-Rosiers (2002), for example, finds that homes adjacent to a power line and facing a HVTL tower sell for as much as 20% less than similar homes that are not facing a HVTL tower.

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characteristic information) and rigorous methodology, hedonic models can also be used as appraisal models. Automated valuation models cannot, however, be reliably used to measure marginal effects because they do not employ sufficient information to do so, and, more importantly, AVMs do not hold controlling characteristics constant, which could bias any resulting estimates of marginal effects.

[12] For further discussion of the hedonic model and its application to the quantification of environmental stigmas in comparison to other methods see Jackson (2005).

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It is unclear how well the existing hedonic literature on other disamenities applies to wind turbines, but there are likely some similarities. For instance, in general, the existing literature seems to suggest that concerns about lasting health effects provide the largest diminution in sales prices, followed by concerns for one's enjoyment of the property, such as auditory and visual nuisances, and that all effects tend to fade with distance to the disamenity - as the perturbation becomes less annoying. This might indicate that property value effects from wind turbines are likely to be the most pronounced quite close to them, but fade quickly as their auditory and visual impacts fade. The existing hedonic literature also, in general, finds that effects fade with time as self-selecting buyers without prejudice towards the disamenity move into the area, or as the real or perceived risks of the disamenity are lessoned (Jackson, 2001). This implies that any stigmas related to wind turbines might also fade over time as local communities come to accept their presence.

2.2. Impacts of Wind Projects on Property Values

Turning to the literature that has investigated the potential property value effects from wind facilities directly, it deserves note that few studies have been academically peer-reviewed and published; in some cases, the work has been performed for a party on one side or the other of the permitting process (e.g., the wind developer or an opposition group). Nonetheless, at a minimum, a brief review of this existing literature will set the stage for and motivate the later discussion of the methods and results of the present work. The literature described below is summarized in Table 1. To frame this discussion, where possible, the three potential stigmas discussed earlier are used:

- Area Stigma: A concern that the general area surrounding a wind energy facility will appear more developed, which may adversely affect home values in the local community regardless of whether any individual home has a view of the wind turbines.
- Scenic Vista Stigma: A concern that a home may be devalued because of the view of a wind energy facility, and the potential impact of that view on an otherwise scenic vista.
- Nuisance Stigma: A concern that factors that may occur in close proximity to wind turbines, such as sound and shadow flicker, will have a unique adverse influence on home values.

In one of the most recent studies, Sims et al. (2008) used a hedonic model to investigate Scenic Vista Stigma using 199 residential transactions within ¼ of a mile of the 16-turbine Bears Down wind facility in Cornwall, UK. They found both large positive and smaller negative significant relationships between views of the turbines and sales prices depending on whether the view is seen from the front or rear of the home, respectively, but found no relationship between the number of wind turbines visible and sales prices. Previously, Sims and Dent (2007) used a hedonic model to investigate Nuisance and Scenic Vista Stigma with 919 transactions for homes within five miles of two wind facilities in the UK, finding only limited evidence of a relationship between proximity to and views of turbines and sales prices, which local real estate experts attributed to other causes. Hoen (2006) investigated Scenic Vista Stigma using a hedonic model to analyze 280 residential transactions occurring near a wind facility in Madison County, NY, and found no evidence that views of turbines significantly affects prices. Jordal-Jorgensen (1996) investigated Nuisance Stigma in Denmark, and found an adverse effect for homes located "close" to the turbines, but no statistical significance was reported.[13]

[13] A copy of this report could not be obtained and therefore its findings are reported based on other citations.

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Using different statistical methods, Poletti (2005; 2007) used a *t*-Test to investigate Nuisance and Area Stigma by comparing the mean sales prices of 187 and 256 homes in Illinois and Wisconsin, respectively, located near wind facilities (target group) to those further away (control group).[14, 15] He split these target and control groups into respective smaller and more-homogenous sub-groups, such as large and small tracts, with and without homes, finding no statistical evidence that homes near the wind facilities sold for different prices than those farther away. Sterzinger et al. (2003) analyzed roughly 24,000 residential transactions, which were divided between those within five miles of a wind facility and those outside of five miles in an effort to assess Area Stigma. They compared residential appreciation rates over time, and found no apparent difference between those homes within and outside of five miles from a wind facility, but the statistical significance of this comparison was not reported.

Other authors have used smaller samples of residential transactions and a variety of simple statistical techniques, without reporting statistical significance, and have found a lack of evidence of effects from Nuisance Stigma (Jerabek, 2001; Jerabek, 2002; Beck, 2004) and Area Stigma (DeLacy, 2005; Goldman, 2006). These results, however, are somewhat contrary to what one appraiser has found. In his investigation of Nuisance Stigma around a wind facility in Lee County, IL, McCann (2008) found that two homes nearby a wind facility had lengthy selling periods that, he believes, also adversely affected transaction prices. Additionally, Kielisch (2009) investigated Nuisance Stigma by comparing twelve transactions of undeveloped land near two wind facilities in Wisconsin (Blue Sky Green Field and Forward) to undeveloped land transactions farther away. He found that land tracts near the wind facilities sold for dramatically lower prices ($/acre) than the comparable group, but the statistical significance of the comparison was not reported.

In addition to these revealed preference studies, a number of stated preference surveys (e.g., contingent valuation) and general opinion surveys have investigated the existence of potential effects.[16] A survey of local residents, conducted after the wind facilities were erected, found no evidence of Area Stigma (Goldman, 2006), while another found limited evidence of these stigmas (Bond, 2008).[17] Similarly, some surveys of real estate experts conducted after facility

[14] A *t*-Test is used to compare two sample means by discerning if one is significantly different from the other.

[15] The 2007 study used the data contained in the 2005 study in combination with new data consisting of transactions that occurred in the interim period.

[16] Contingent valuation is a survey based technique to value non-market goods (e.g., an environmental disamenity) that asks respondents what their "willingness to pay" (or "willingness to accept") is to have, for instance, a disamenity removed from (or to have it remain in) their neighborhood. This technique is distinct from a general opinion survey, which might ask whether respondents believe property values have been impacted by an environmental disamenity and, if so, "by how much." Although there are important distinctions between the two techniques, with the contingent valuation method often preferred by economic practitioners, for simplicity no distinction is made here between these two approaches. Finally, another subset of the survey literature focuses on public acceptance (i.e., opinion). Though these public acceptance surveys sometimes cover possible impacts on property values, those impacts are not quantified in economic terms. As a result, public acceptance survey results are not reported here.

[17] Bond (2008) asked respondents to declare if the wind facility, which is located roughly 7 miles away, would effect what they would be willing to pay for their house and 75% said either they would pay the same or more for their house, while the remainder would pay less. When those latter respondents were asked to estimate the percentage difference in value, their estimates averaged roughly 5%.

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construction have found no evidence of Area or Nuisance Stigmas (Grover, 2002; Goldman, 2006). These results, however, are contrary to the expectations for Area, Scenic Vista, and Nuisance Stigma effects predicted by local residents (Haughton et al., 2004; Firestone et al., 2007) and real estate experts (Haughton et al., 2004; Khatri, 2004; Kielisch, 2009) prior to construction found elsewhere.[18] The difference between predicted and actual effects might be attributable, at least in part, to the fear of the unknown. For instance, Wolsink (1989) found that public attitudes toward wind power, on average, are at their lowest for local residents during the wind project planning stage, but return almost to pre-announcement levels after the facilities are built. This result is echoed by Exeter-Enterprises-Ltd. (1993) and Palmer (1997), whose post-construction surveys found higher approval than those conducted pre-construction. Others, however, have found that perceptions do not always improve, attributing the lack of improvement to the perceived "success" or lack therefore of the project, with strong disapproval forming if turbines sit idle (Thayer and Freeman, 1987) or are perceived as a waste of taxpayer dollars (Devine-Wright, 2004).

When this literature is looked at as a whole, it appears as if wind projects have been predicted to negatively impact residential property values when pre-construction surveys are conducted, but that sizable, widespread, and statistically significant negative impacts have largely failed to materialize post-construction when actual transaction data become available for analysis. The studies that have investigated Area Stigma with market data have failed to uncover any pervasive effect. Of the studies focused on Scenic Vista and Nuisance Stigmas, only one is known to have found statistically significant adverse effects, yet the authors contend that those effects are likely driven by variables omitted from their analysis (Sims and Dent, 2007). Other studies that have relied on market data have sometimes found the possibility of negative effects, but the statistical significance of those results have rarely been reported.

Despite these findings, the existing literature leaves much to be desired. First, many studies have relied on surveys of homeowners or real estate professionals, rather than trying to quantify real price impacts based on market data. Second, a number of studies conducted rather simplified analyses of the underlying data, potentially not controlling for the many drivers of residential sales prices. Third, many of the studies have relied upon a very limited number of residential sales transactions, and therefore may not have had an adequate sample to statistically discern any property value effects, even if effects did exist. Fourth, and perhaps as a result, many of the studies did not conduct, or at least have not published, the statistical significance of their results. Fifth, when analyzed, there has been some emphasis on Area Stigma, and none of the studies have investigated all three possible stigmas simultaneously. Sixth, only a few of the studies (Hoen, 2006; Sims and Dent, 2007; Sims et al., 2008; Kielisch, 2009) conducted field visits to the homes to assess the quality of the scenic vista from the home, and the degree to which the wind facility might impact that scenic vista. Finally, with two exceptions (Sims and Dent, 2007; Sims et al., 2008), none of the studies have been academically peer-reviewed and published.

[18] It should be noted that the samples used by both Khatri and Kielisch contained a subset of respondents who did have some familiarity with valuing homes near wind facilities.

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Table 1: Summary of Existing Literature on Impacts of Wind Projects on Property Values

Document Type Author(s)	Year	Number of Transactions or Respondents	Before or After Wind Facility Construction Commenced	Area Stigma	Scenic Vista Stigma	Nuisance Stigma
Homeowner Survey						
Haughton et al.	2004	501	Before	- *	- *	
Goldman	2006	50	After	**none**		
Firestone et al.	2007	504	Before	- *	- *	
Bond	2008	~300	After		- ?	- ?
Expert Survey						
Grover	2002	13	After	**none**		**none**
Haughton et al.	2004	45	Before	- *	- *	
Khatri	2004	405	Before‡	- ?		- ?
Goldman	2006	50	After	**none**		**none**
Kielisch	2009	57	Before‡			- ?
Transaction Analysis - Simple Statistics						
Jerabek	2001	25	After			**none**
Jerabek	2002	7	After			**none**
Sterzinger et al.	2003	24,000	After	**none**		
Beck	2004	2	After			**none**
Poletti	2005	187	After	**none**		**none**
DeLacy	2005	21	Before†	**none**		
Goldman	2006	4	After	**none**		
Poletti	2007	256	After	**none**		**none**
McCann	2008	2	After			- ?
Kielisch	2009	103	After			- ?
Transaction Analysis - Hedonic Model						
Jordal-Jorgensen	1996	?	After			- ?
Hoen	2006	280	After		**none**	
Sims & Dent	2007	919	After			- *
Sims et al.	2008	199	After		-/+ *	

" none " indicates the majority of the respondents do not believe properties have been affected (for surveys) or that no effect was detected at 10% significance level (for transaction analysis)

"- ?" *indicates a negative effect without statistical significance provided*

"- *" *indicates statistically significant negative effect at 10% significance level*

"-/+ *" *indicates positive and negative statistically significant effects at 10% significance level*

† *Sales were collected after facility announcement but before construction*

‡ *Some respondents had experience with valuations near facilities while others did not*

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3. Data Overview

The methods applied in the present work are intended to overcome many of the limitations of the existing literature. First, a large amount of data is collected from residential transactions within 10 miles of 24 different wind projects in the U.S., allowing for a robust statistical analysis across a pooled dataset that includes a diverse group of wind project sites. Second, all three potential stigmas are investigated by exploring the potential impact of wind projects on home values based both on the distance to and view of the projects from the homes. Third, field visits are made to every home in the sample, allowing for a solid assessment of the scenic vista enjoyed by each home and the degree to which the wind facility can be seen from the home, and to collect other value-influencing data from the field (e.g., if the home is situated on a cul-de-sac). Finally, a number of hedonic regression models are applied to the resulting dataset, as are repeat sales and sales volume analyses, in order to assess the robustness of the results.

Testing for the three potential stigmas requires a significant sample of residential transactions within close proximity to existing wind facilities. Unfortunately for the study, most wind power projects are not located near densely populated areas. As a result, finding a single wind project site with enough transaction data to rigorously analyze was not possible. Instead, the approach was to collect data from multiple wind project sites, with the resulting data then pooled together to allow for robust statistical analyses.[19] The remainder of this section describes the site selection process that is used, and provides a brief overview of both the selected study areas and the data that were collected from these areas. Also provided is a description of how scenic vista, views of turbines, and distances from turbines were quantified for use in the hedonic analysis, and a summary of the field data collection effort. The section ends with a brief summary of the resulting dataset.

3.1. Site Selection

For the purpose of this study, an ideal wind project area would:

1) Have a large number of residential transactions both before and, more importantly, after wind facility construction, and especially in close proximity (e.g., within 2 miles) of the facility;
2) Have comprehensive data on home characteristics, sales prices, and locations that are readily available in electronic form; and
3) Be reasonably representative of the types of wind power projects being installed in the United States.

To identify appropriate sites that met these criteria, and that also provided a diversity of locations, the authors obtained from Energy Velocity, LLC a set of Geographic Information System (GIS) coordinates representing 241 wind projects in the U.S. that each had a total nameplate capacity greater than 0.6 megawatts (MW) and had gone online before 2006.[20] Also provided were facility capacity, number of turbines, and announcement, construction, and operational dates. These data were cross-checked with a similar dataset provided by the American Wind Energy Association (AWEA), which also included some turbine hub-height information.

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[19] A thorough discussion of this "pooled" approach is contained in Section 4.2 and in Appendix F.

[20] Energy Velocity, LLC was owned at the time by Global Energy Decisions, which was later purchased by Ventyx. The dataset is available as Velocity Suite 2008 from Ventyx.

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By using a variety of different GIS sorting techniques involving nearby towns with populations greater than, for example, 2,500 people, using census tract population densities, and having discussions with wind energy stakeholders, a prospective list of 56 possible study areas was generated, which were then ranked using two scales: "highly desirable" to "least desirable," and "feasible" to "potentially unfeasible."[21] Then, through an iterative process that combined calls to county officials to discuss the number of residential transactions and data availability, with investigations using mapping software to find the location of individual wind turbines, and, in some cases, preliminary visits, a list of 17 prospective study areas were chosen as both "highly desirable" and "feasible." Ultimately, three of these proved to be "unfeasible" because of data availability issues and four "undesirable" because the study area was considered not representative. This effort ultimately resulted in a final set of ten study areas that encompass a total of 24 distinct wind facilities (see Figure 1 and Table 2).[22] A full description of each study area is provided in Appendix A.

[21] "Desirability" was a combination of a number of factors: the wind facility having more than one turbine; the study area having greater than 350 sales within 5 miles and within 10 years, 250 of which transacted following construction of the facility; having some transaction data old enough to pre-date facility announcement; having data on the core home and site characteristics (e.g., square feet, acres); and, where possible, having a concentration of sales within 1 mile of the facility. "Feasibility" was also a combination of factors: having home characteristic and sales data in electronic form; having GIS shapefiles of the parcel locations; and being granted ready access to this information.

[22] The "unfeasible" study areas were Cerro Gordo County, IA, Bennington County, VT, and Atlantic County, NJ. Cerro Gordo County, IA contained multiple wind projects totaling 140 MW. Although the data at this site were available in electronic form, the county only agreed to share data in paper form, which would have created an enormous data entry burden. Because another site in the sample was considered similar to the Cerro Gordo site (IABV), Cerro Gordo County was dropped from the prospective sites. Bennington County, VT contained the 11 turbine Searsburg Wind Project (6 MW) but had no electronic records. Atlantic County, NJ contained the five turbine Jersey Atlantic Wind Farm (7.5 MW), but had data in paper records only and the county was unresponsive to inquiries regarding the study. The "undesirable" study areas were Plymouth County, MA, Wood County, OH, Cascade County, MT, and Riverside County, CA. Although the data in Plymouth County, MA were more than adequate, this small, on-land, yet coastal Hull Wind facility (2 turbines, 2.5 MW) was not considered to be particularly representative of wind development across the US. Wood County's four turbine Bowling Green facility (7 MW) met the appropriate data requirements, but ultimately it was decided that this facility was too small and remote to be representative. Cascade County's six turbine Horseshoe Bend Wind Park (9 MW) did not have enough transactions to justify study. Riverside, CA, where roughly 2500 turbines are located, had less-than-desired home characteristic data, had transactions that came more than 10 years after large scale development began, and despite having homes that were within 1 mile of the turbines, those homes typically had limited views because of high subdivision walls.

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Figure 1: Map of Study Areas and Potential Study Areas

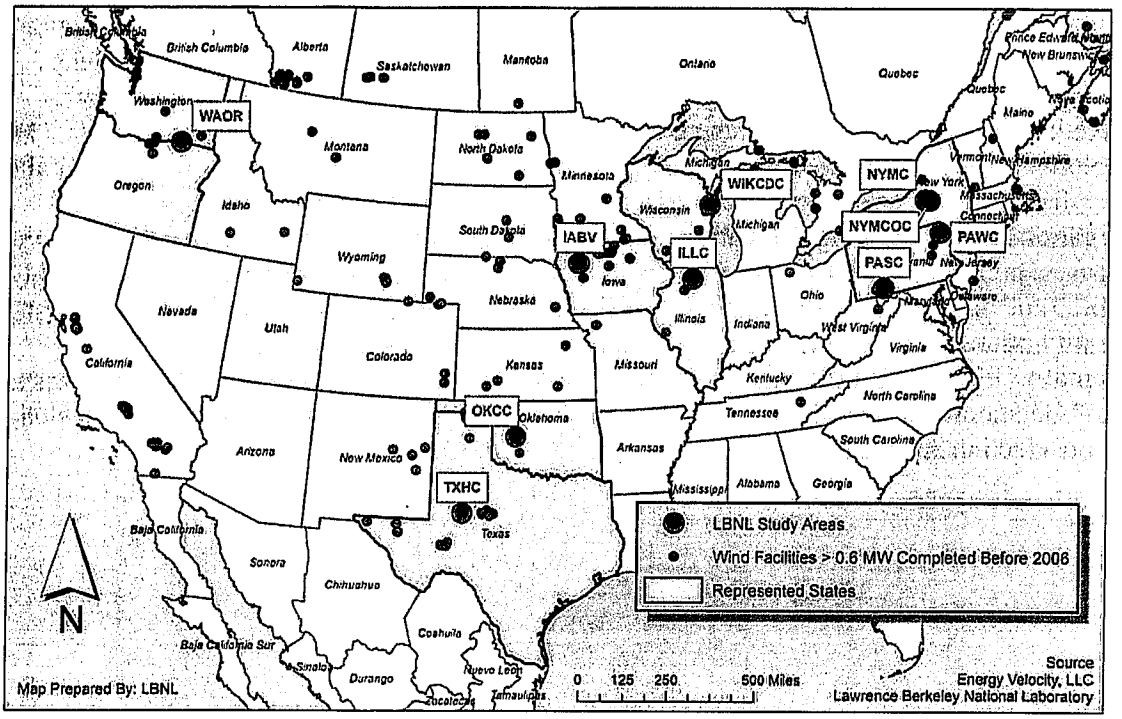

Table 2: Summary of Study Areas

Study Area Code	Study Area Counties, States	Facility Names	Number of Turbines	Number of MW	Max Hub Height (meters)	Max Hub Height (feet)
WAOR	Benton and Walla Walla Counties, WA and Umatilla County, OR	Vansycle Ridge, Stateline, Nine Canyon I & II, Combine Hills	582	429	60	197
TXHC	Howard County, TX	Big Spring I & II	46	34	80	262
OKCC	Custer County, OK	Weatherford I & II	98	147	80	262
IABV	Buena Vista County, IA	Storm Lake I & II, Waverly, Intrepid I & II	381	370	65	213
ILLC	Lee County, IL	Mendota Hills, GSG Wind	103	130	78	256
WIKCDC	Kewaunee and Door Counties, WI	Red River, Lincoln	31	20	65	213
PASC	Somerset County, PA	Green Mountain, Somerset, Meyersdale	34	49	80	262
PAWC	Wayne County, PA	Waymart	43	65	65	213
NYMCOC	Madison and Oneida Counties, NY	Madison	7	12	67	220
NYMC	Madison County, NY	Fenner	20	30	66	218
		TOTAL	**1345**	**1286**		

These 10 study areas and 24 projects are located in nine separate states, and include projects in the Pacific Northwest, upper Midwest, the Northeast, and the South Central region. The wind projects included in the sample total 1,286 MW, or roughly 13% of total U.S. wind power capacity installed at the time (the end of 2005). Turbine hub heights in the sample range from a

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minimum of 164 feet (50 meters) in the Washington/Oregon (WAOR) study area, to a maximum of 262 (80 meters) (TXHC, OKCC and PASC), with nine of the ten study areas having hub heights of at least 213 feet (65 meters). The sites include a diverse variety of land types, including combinations of ridgeline (WAOR, PASC, and PAWC), rolling hills (ILLC, WIKCDC, NYMCOC, and NYMC), mesa (TXHC), and windswept plains (OKCC, IABV).[23]

3.2. Data Collection

In general, for each study area, residential transaction data in as close proximity to the wind turbines as possible was sought, from both before and after wind facility construction. To balance the cost and quantity of data collection in each study area with the desire to cover as many study areas as possible, the research effort sought to collect data on 400 to 1,250 transactions in each study area.[24] In some instances, this meant including all residential transactions within ten miles of the wind turbines. In others, only transactions within five miles were included. In some extreme instances, when the number of transactions inside of five miles far exceeded the 1,250 limit, all transactions in close proximity to the wind turbines (e.g., inside three miles) were included in combination with a random sample of transactions outside of that distance band (e.g., between three and five miles).[25] The data selection processes for each Study Area are contained in Appendix A.

Three primary sets of data are used in the analysis: tabular data, GIS data, and field data, each of which is discussed below. Following that, this subsection highlights the two qualitative variables that are essential to this analysis and that therefore require special attention, scenic vista and views of turbines, and then discusses the field data collection process.

3.2.1. Tabular Data

Berkeley Lab obtained tabular transaction data from participating counties[26] containing 7,459 "valid" [27] transactions of single family residential homes, on less than 25 acres,[28] which were

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[23] Some areas, such as PASC, had both a ridgeline and rolling hills on which wind facilities were located.

[24] This range was chosen to ensure that a minimum of data were present in each study area to allow for a robust analysis, and yet not too much so as to make data collection (e.g., the visiting of each home) inordinately time and resource consuming in any individual study area.

[25] An alternative method would have been to collect data on every sale that occurred. Although in most cases this would be preferred, in ours it would not have added one additional transaction within close proximity or with dramatic views of wind turbine, the focus of the study. Rather, it would have added an overwhelming majority of transactions of homes without views and at distances outside of three miles from the turbines, all of which would have come at considerably cost and, more importantly, would not likely have influenced the results significantly while perhaps necessitating a reduction in the total number of study areas that could be included in the sample.

[26] In some cases, the county officials, themselves, extracted data from their database, and in some cases a company engaged to manage a county's data provided the necessary information. In either case the provider is referred to as "county." Detailed descriptions of the providers are presented in Appendix A.

[27] Validity was determined by each individual county data provider. A sale that is considered "valid" for county purposes would normally meet the minimum requirements of being arm's length; being a transfer of all rights and warrants associated with the real estate; containing an insignificant amount of personal property so as not to affect the price; demonstrating that neither party in the sale acting under duress or coercion; not being the result of a liquidation of assets or any other auction, a mortgage foreclosure, a tax sale, or a quit claim; and being appropriate for use in calculating the sales price to assessed value ratios that are reported to the state. Due to the formal requirements associated with this calculation, "validity" is often defined by a state's Department of Revenue, as shown, for example, here: http://www.orps.state.ny.us/assessor/manuals/vol6/rfv/index.htm. In addition, though the

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sold for a price of more than $10,000,[29] which occurred after January 1, 1996,[30] and which had fully populated "core" home characteristics. These core characteristics are: number of square feet of the living area (not including finished basement), acres of land, bathrooms, and fireplaces, the year the home was built,[31] if the home had exterior wallsthatwere stone, a central air conditioning unit, and/or a finished basement, and the exterior condition of the home. The 7,459 residential transactions in the sample consist of 6,194 homes (a number of the homes in the sample sold more than once in the selected study period). Because each transaction had a corresponding set of the core home characteristic data, they could all be pooled into a single model. In addition to the home characteristic data, each county provided, at a minimum, the home's physical address and sales price. The counties often also provided data on homes in the study area that did not sell in the study period.[32] Finally, market-specific quarterly housing inflation indexes were obtained from Freddie Mac, which allowed nominal sales prices to be adjusted to 1996 dollars.[33]

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sample originally contained 7,498 sales, 34 homes sold twice in a 6 month period and, after discussions with local officials, these transactions were considered likely to have been "invalid" despite the county coding them to the contrary. Additionally, five transactions produced standardized residuals that were more than six standard deviations away from the mean, indicating that these sales were abnormal and likely not valid. Both of these sets of transactions, totaling 39, were removed from the final dataset. Of the 39 sales, 32 sold following construction, 10 were concentrated in IABV and nine in TXHC with the others spread between seven of the remaining eight study areas. One of the homes was inside of one mile from the turbines at the time of sale, and two had views of the turbines (both of which were MINOR). The home that was located within one mile was surrounded by a number of other homes – at similar distances from the turbines - that transacted both before and after the wind facilities were built and were included in the sample. A more thorough discussion of the screening techniques used to ensure the appropriateness of the final data set are presented in detail in Appendix G under "Outliers/Influencers." Finally, it should be noted that the authors are aware of four instances in the study areas when homes were sold to wind developers. In two cases the developer did not resell the home; in the other two, the developer resold the home at a lower price than which it was purchased. But, because the sales were to a related party, these transactions were not considered "valid' and are therefore not included here. One might, however, reasonably expect that the property values of these homes were impacted by the presence of the wind turbines.

[28] Single family residences on more than 25 acres were considered to be likely candidates for alternative uses, such as agricultural and recreational, which could have an influence on sales price that was outside of the capabilities of the model to estimate. Because all records were for parcels that contained a residence, the model did not contain any "land-only" transactions. Further, none of the transactions provided for this research were for parcels on which a turbine was located.

[29] A sales price of $10,000 was considered the absolute minimum amount an improved parcel (one containing a residential structure) would sell for in any of the study areas and study periods. This provided an additional screen over and above the "valid" screen that the counties performed.

[30] This provided a maximum of 12 years of data. Some counties did not have accessible data back to 1996 but in all cases these countries had data on transactions that occurred before the wind facilities were erected.

[31] "Year Built" was used to construct a variable for the age of the home at the time of the sale.

[32] These data were used to calculate the "Sales Volume" percentages referred to in Section 7.

[33] Freddie Mac Conventional Mortgage Home Price Index: municipal statistical area (MSA) series data are available from the following site: http://www.freddiemac.com/finance/cmhpi/. Because most of the study areas do not fall within the MSAs, a collection of local experts was relied upon, including real estate agents, assessors, and appraisers, to decide which MSA most-closely matched that of the local market. In all cases the experts had consensus as to the best MSA to use. In one case (NYMCOC) the sample was split between two MSAs. These indexes are adjusted quarterly, and span the entire sample period. Therefore, during the housing boom, insofar as a boom occurred in the sample areas, the indexes increased in value. Subsequently when the market began falling, the index retracted.

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3.2.2. GIS Data

GIS data on parcel location and shape were also required, and were obtained from the counties. The counties also often provided GIS layers for roads, water courses, water bodies, wind turbines (in some cases), house locations, and school district and township/town/village delineations. GIS data on census tract and school district delineations were obtained from the U.S. Census Bureau, if not provided by the county.[34] GIS data were obtained on water courses, water bodies, land elevations, and satellite imagery, as was necessary, from the U.S. Department of Agriculture.[35] Combined, these data allowed each home to be identified in the field, the construction of a GIS layer of wind turbine locations for each facility, and the calculation of the distance from each home to the nearest wind turbine.[36] Determining the distance from each home to the nearest wind turbine was a somewhat involved process, and is discussed in detail in Appendix B. Suffice it to say that each transaction had a unique distance ("DISTANCE")[37] that was determined as the distance between the home and nearest wind turbine at the time of sale, and that these distances are grouped into five categories: inside of 3000 feet (0.57 miles), between 3000 feet and one mile, between one and three miles, between three and five miles, and outside of five miles.[38] Finally, the GIS data were used to discern if the home was situated on a cul-de-sac and had water frontage, both of which were corroborated in the field.

3.2.3. Field Data

Additional data had to be collected through field visits to all homes in the sample. Two qualitative measures in particular – for scenic vista and for view of the wind turbines – are worth discussing in detail because each is essential to the analysis and each required some amount of professional judgment in its creation.

The impact or severity of the view of wind turbines ("VIEW") [39] may be related to some combination of the number of turbines that are visible, the amount of each turbine that is visible (e.g., just the tips of the blades or all of the blades and the tower), the distance to the nearest turbines, the direction that the turbines are arrayed in relation to the viewer (e.g., parallel or perpendicular), the contrast of the turbines to their background, and the degree to which the turbine arrays are harmoniously placed into the landscape (Gipe, 2002). Recent efforts have made some progress in developing quantitative measures of the aesthetic impacts of wind turbines (Torres-Sibillea et al., 2009),[40] but, at the time this project began, few measures had

[34] These data were sourced from the U.S. Census Bureau's Cartographic Boundary Files Webpage: http://www.census.gov/geo/www/cob/bdy_files.html.

[35] These data were sourced from the USDA Geospatial Data Gateway: http://datagateway.nrcs.usda.gov/GatewayHome.html.

[36] Although in some cases the county provided a GIS layer containing wind turbine points, often this was not available. A description of the turbine mapping process is provided in Appendix B.

[37] Distance measures are collectively and individually referred to as "DISTANCE" from this point forward.

[38] The minimum distance of "inside 3000 feet" was chosen because it was the closest cutoff that still provided an ample supply of data for analysis.

[39] View of turbines ratings are collectively and individually referred to as "VIEW" from this point forward.

[40] In addition to these possible field techniques, previous studies have attempted to use GIS to estimate wind turbine visibility using "line-of-sight" algorithms. For example, Hoen (2006) used these algorithms after adding ground cover to the underlying elevation layer. He found that the GIS method differed substantially from the data collected in the field. Seemingly, small inaccuracies in the underlying elevation model, errors in the software's algorithm, and the existence of ground cover not fully accounted for in the GIS, substantially biased GIS-based assessments of

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been developed, and what had been developed was difficult to apply in the field (e.g., Bishop, 2002). As a result, the authors opted to develop an ordered qualitative VIEW rating system that consisted of placing the view of turbines into one of five possible categories: NO VIEW, MINOR, MODERATE, SUBSTANTIAL, and EXTREME. These ratings were developed to encompass considerations of distance, number of turbines visible, and viewing angle into one ordered categorical scale, and each rating is defined in Table 3:[41]

Table 3: Definition of VIEW Categories

NO VIEW	The turbines are not visible at all from this home.
MINOR VIEW	The turbines are visible, but the scope (viewing angle) is narrow, there are many obstructions, or the distance between the home and the facility is large.
MODERATE VIEW	The turbines are visible, but the scope is either narrow or medium, there might be some obstructions, and the distance between the home and the facility is most likely a few miles.
SUBSTANTIAL VIEW	The turbines are dramatically visible from the home. The turbines are likely visible in a wide scope and most likely the distance between the home and the facility is short.
EXTREME VIEW	This rating is reserved for sites that are unmistakably dominated by the presence of the wind facility. The turbines are dramatically visible from the home and there is a looming quality to their placement. The turbines are often visible in a wide scope or the distance to the facility is very small.

Photographic examples of each of the categories are contained in Appendix E.

visibility. This was corroborated elsewhere by Maloy and Dean (2001) and Riggs and Dean (2007). As a result of these findings, it was determined that field collection of VIEW data was essential.

[41]In addition to the qualitative rating system that was ultimately used in this study, a variety of quantitative data were collected that might describe the nature of the view of wind turbines, including the total number of turbines visible, the distance of the home to the nearest wind turbine, and the view scope/viewing angle (i.e., the degree to which the turbines spread out in front of the home: narrow, medium, or wide). To explore the validity of the qualitative rating scale two tests were conducted. First, a pre-study survey was conducted by showing 10 different off-site respondents 15 randomly selected photographs from the field representing the various rated VIEW categories. The higher VIEW ratings were oversampled to create a roughly equal distribution among the categories. The respondents rated the views into one of the qualitative categories. The on-site / field collected ratings matched the off-site responses 65% of the time, with 97% of the rankings differing by no more than one category. Ninety-eight percent of the on-site-ranked MINOR VIEWs and 89% of the EXTREME VIEWs were similarly ranked by off-site respondents. The on-site rankings were less than the off-site rankings 97% of the time; it is assumed that this is because on-site ratings took into account a greater portion of the panorama than were captured in the photos, which translated into a lower ranking. Secondly, a post hoc Multinomial Logistic Regression model was created that used the qualitative on-site VIEW ratings as the dependent variable and the quantitative measures of distance to nearest turbine, number of turbines visible, and view scope as the independent variables. This model produced high Pseudo R^2 statistics (Cox and Snell 0.88, Nagelkerke 0.95, and McFadden 0.79) and predicted values that were highly correlated with the actual qualitative rating (Pearson's 0.88). Therefore, both tests corroborated the appropriateness of the simpler qualitative VIEW rankings used herein.

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In addition to the qualitative VIEW measurements, a rating for the quality of the scenic vista ("VISTA")[42] from each home, absent the existence of the wind facilities, was also collected in the field. An assessment of the quality of the VISTA from each home was needed because VIEW and VISTA are expected to be correlated; for example, homes with a PREMIUM VISTA are more likely to have a wide viewing angle in which wind turbines might also be seen. Therefore, to accurately measure the impacts of the VIEW of wind turbines on property values a concurrent control for VISTA (independent of any views of turbines) is required. Drawing heavily on the landscape-quality rating system developed by Buhyoff et al. (1994) and to a lesser degree on the systems described by others (Daniel and Boster, 1976; USDA, 1995), an ordered VISTA rating system consisting of five categories was developed: POOR, BELOW AVERAGE, AVERAGE, ABOVE AVERAGE, and PREMIUM, with each rating defined in Table 4:[43]

Table 4: Definition of VISTA Categories

POOR VISTA	These vistas are often dominated by visually discordant man-made alterations (not considering turbines), or are uncomfortable spaces for people, lack interest, or have virtually no recreational potential.
BELOW AVERAGE VISTA	These scenic vistas contain visually discordant man-made alterations (not considering turbines) but are not dominated by them. They are not inviting spaces for people, but are not uncomfortable. They have little interest or mystery and have minor recreational potential.
AVERAGE VISTA	These scenic vistas include interesting views that can be enjoyed often only in a narrow scope. These vistas may contain some visually discordant man-made alterations (not considering turbines), are moderately comfortable spaces for people, have some interest, and have minor recreational potential.
ABOVE AVERAGE VISTA	These scenic vistas include interesting views that often can be enjoyed in a medium to wide scope. They might contain some man-made alterations (not considering turbines), yet still possess significant interest and mystery, are moderately balanced and have some potential for recreation.
PREMIUM VISTA	These scenic vistas would include "picture postcard" views that can be enjoyed in a wide scope. They are often free or largely free of any discordant man made alterations (not considering turbines), possess significant interest, memorable qualities, and mystery and are well balanced and likely have a high potential for recreation.

Photographic examples of each of the categories are contained in Appendix D.

[42] Scenic vista ratings are individually and collectively referred to as "VISTA" from this point forward.

[43] The appropriateness of these rankings were tested in two ways. First, a set of 34 pictures taken on-site and representing various categories of VISTA were shown to 10 off-site respondents who were asked to rank them using the same categories, and then explain why they rated them as such. Although the off-site ratings matched the on-site ratings only 51% of the time, 94% of on- and off-site rankings differed by no more than one category, with 17% of the off-site rankings below the on-site and 26% ranked above. The descriptions of why the rankings where chosen by the off-site respondents illuminated the fact that off-site ratings did not take into account a number of aspects that were not adequately captured in the photos, but that were apparent in the field. This finding was borne out by a second test that had five individuals visit seven homes in the field to rank their scenic vistas. When all respondents were on-site, they similarly ranked the vista 72% of the time, with a rankingthat differed by no more than one category occurring one hundred percent of the time.

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In addition to the VIEW and VISTA ratings, it was assumed that the orientation of the home to the view of turbines (e.g., front, back, or side) ("ORIENTATION"), and the degree to which the view of the turbines overlapped the primary scenic vista (e.g., not at all, barely, somewhat or strongly) ("OVERLAP"), might influence residential property values. As such, information on ORIENTATION and OVERLAP were also collected in the field.

3.2.4. Field Data Collection

Field data collection was conducted on a house-by-house basis. Each of the 6,194 homes was visited by the same individual to remove bias among field ratings. Data collection was conducted in the fall of 2006, and the spring, summer, and fall of 2007 and 2008. Each house was photographed and, when appropriate, so too were views of turbines and the prominent scenic vista.[44] Data on VIEW were collected only for those homes that sold after at least one wind power facility had been erected in the study area. When multiple wind facilities, with different construction dates, were visible from a home, field ratings for VIEW were made by taking into account which turbines had been erected at the time of sale. Additionally, if the season at the time of sale differed from that of data collection and, for example, if leaves were off the trees for one but on for the other, an effort was made to modulate the VIEW rating accordingly if necessary.[45]

Both VIEW and VISTA field ratings were arrived at through a Q-Sort method (Pitt and Zube, 1979), which is used to distinguish relatively similar rankings. For views of turbines, the rater first determined if the ranking was MINOR or EXTREME. If neither of these two rankings was appropriate, then only a choice between MODERATE and SUBSTANTIAL was required. Similarly, for VISTA rankings, first POOR and PREMIUM were distinguished from the others; if neither applied then BELOW AVERAGE or ABOVE AVERAGE could be selected. If neither of those were appropriate the VISTA, by default, was considered AVERAGE. In all cases, if wind turbines were visible from the home, the VISTA rankings were made as if those turbines did not exist.

3.3. Data Summary

The final dataset consists of 7,459 valid and screened residential transactions occurring between January 2, 1996 and June 30, 2007. Those transactions are arrayed across time and the ten wind project study areas as shown in Table 5. The sample of valid residential transactions ranges from 412 in Lee County, Illinois (ILLC) to 1,311 in Howard County, Texas (TXHC).[46] Of the total 7,459 transactions, 4,937 occurred after construction commenced on the relevant wind facilities. More specifically, 23% of the transactions (n=1,755) took place before any wind facility was announced and 10% occurred after announcement but before construction commenced (n=767),

[44] In many cases the prominent VISTA was homogenous across groups of home, for instance urban homes on the same road. In those cases a picture of the VISTA of one home was applied to all of the homes. All pictures were taken with a Canon EOS Rebel XTi Single Lens Reflex Camera with a 18-55mm lens. VIEW and VISTA pictures were taken with the lens set to 18mm, with the camera at head height, and with the center of the camera pointed at the center of the prominent VISTA or VIEW. Examples of the various VISTA and VIEW categories are contained in Appendices D and E respectively.

[45] This "modulation" occurred only for trees in the foreground, where, for instance, a single tree could obscure the view of turbines; this would not be the case for trees nearer the horizon.

[46] See description of "valid" in footnote 27 on page 13.

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with the rest of the transactions occurring after construction commenced (66%, n=4,937).[47] Of that latter group, 17% (n=824, 11% of total) sold in the first year following the commencement of construction, 16% in the second year (n=811, 11% of total), and the remainder (67%) sold more than two years after construction commenced (n=3,302, 44% of total).

Table 5: Summary of Transactions across Study Areas and Development Periods

	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Benton/Walla Walla, WA & Umatilla, OR (WAOR)	226	45	76	59	384	790
Howard, TX (TXHC)	169	71	113	131	827	1311
Custer, OK (OKCC)	484	153	193	187	96	1113
Buena Vista, IA (IABV)	152	65	80	70	455	822
Lee, IL (ILLC)	115	84	62	71	80	412
Kewaunee/Door, WI (WIKCDC)	44	41	68	62	595	810
Somerset, PA (PASC)	175	28	46	60	185	494
Wayne, PA (PAWC)	223	106	64	71	87	551
Madison/Oneida, NY (MYMCOC)	108	9	48	30	268	463
Madison, NY (NYMC)	59	165	74	70	325	693
TOTAL	1755	767	824	811	3302	7459

A basic summary of the resulting dataset, including the many independent variables used in the hedonic models described later, is contained in Table 6 and Table 7. These tables present summary information for the full dataset (7,459 transactions) as well as the post-construction subset of that dataset (4,937 transactions); the latter is provided because much of the analysis that follows focuses on those homes that sold after wind facility construction. The mean nominal residential transaction price in the sample is $102,968, or $79,114 in 1996 dollars. The average house in the sample can be described as follows: it is 46 years old, has 1,620 square feet of finished living area above ground, is situated on 1.13 acres, has 1.74 bathrooms, and has a

[47] The announcement date (as well as construction and online dates) was provided by Energy Velocity with the GIS files as described in footnote 20 on page 10. The date corresponds to the first time the facility appears in the public record, which was often the permit application date. This constitutes the first well established date when the existing wind facility would have been likely known by the public, and therefore is appropriate to use for this analysis, but there remain a number of areas for potential bias in this date. First, the permit application date might be preceded by news reports of the impending application; alternatively, if the public record was not published online (that Energy Velocity used to establish their date), the "announcement" date – as used here - could, in fact, follow the permit application date. To address this, when possible, the authors had discussions with the developer of the facility. In most cases, the Energy Velocity dates were found to be accurate, and when they were not they were adjusted to reflect the dates provided by the developer. A second potential source of bias is the possibility that a different project was proposed but never built, but that influenced the residential market in the study area prior to the "announcement" date. Although this is likely rarer, we are aware of at least a few projects that fit that description in the study areas. A final source of bias might revolve around the likelihood that awareness of a project could occur even before the facility is formally announced. For example, a community member might know that a wind facility is being considered because they had been approached by the wind development company well ahead of a public announcement. In turn, they might have had private discussions regarding the facility with other members of the community. Taken together, it is appropriate to assume that there is some bias in the "announcement" date, and that awareness of the project might precede the date used in this analysis. How this bias might affect the results in this report is addressed further in Section 5.3 and footnote 74 on page 38.

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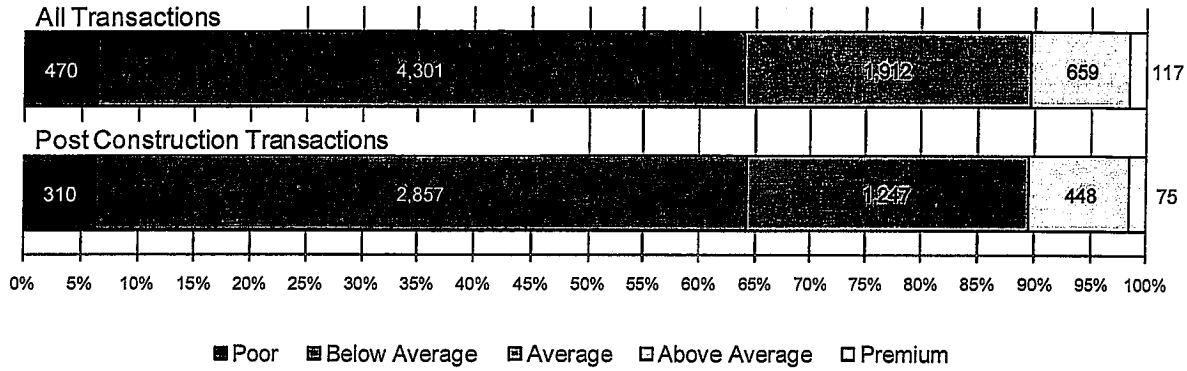
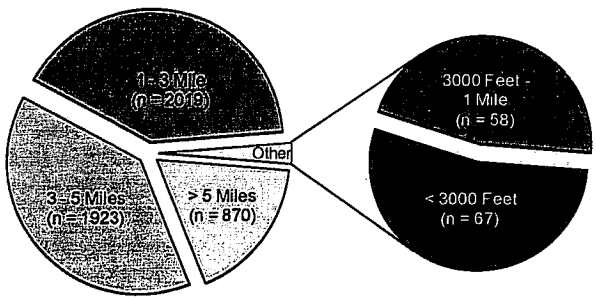
slightly better than average condition.[48] Within the full sample, 6% and 58% of homes had a poor or below average VISTA rating, respectively; 26% of homes received an average rating on this scale, with 9% above average and 2% experiencing premium vistas (see Figure 2).

Figure 2: Frequency of VISTA Ratings for All and Post-Construction Transactions



With respect to the variables of interest, among the post-construction subset of 4,937 transactions, the frequency of the DISTANCE categories is found to follow geometry with the smallest numbers of transactions occurring near the wind turbines and ever increasing numbers further away (see Figure 3). 67 transactions (1%) are situated inside of 3,000 feet (< 0.57 Miles), 58 (1%) are between 3,000 feet and one mile (0.57-1 mile), 2,019 (41%) occur outside of one mile but inside of three miles (1-3 miles), 1,923 (39%) occur between three and five miles (3-5 miles), and 870 (18%) occur outside of five miles (>5 miles).[49] In this same post-construction group, a total of 730 homes that sold (15%) have a view of the wind turbines (see Figure 4). A large majority of those homes have MINOR view ratings (n = 561, 11% of total), with 2% having MODERATE ratings (n=106) and the remaining transactions roughly split between SUBSTANTIAL and EXTREME ratings (n=35, 0.6%, and n=28, 0.5%, respectively). A full description of the variables of interest and how they are arrayed at the study area level is contained in Appendix A.

Figure 3: Frequency of DISTANCE Ratings for Post-Construction Transactions



[48] The variable for the condition of the home was not uniform across study areas because, in some cases, it took into account construction grade while in others it did not.

[49] These numbers and percentages are skewed slightly from the overall population of transactions because homes outside of three miles were often under-sampled to reduce field data collection burdens. Further, higher numbers of homes fall into each of the categories when the post-announcement-pre-construction transactions are included, as they are in some models. These additional transactions are described below in Table 7 under "All Sales."

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Figure 4: Frequency of VIEW Ratings for Post-Construction Transactions

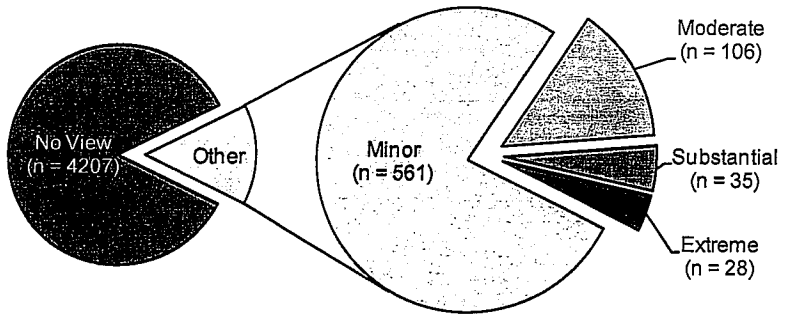

Table 6: Summary Statistics: All Sales and Post-Construction Sales

		All Sales			Post Construction Sales		
Variable Name	**Description**	**Freq. ***	**Mean**	**Std. Dev.**	**Freq. ***	**Mean**	**Std. Dev.**
SalePrice	The unadjusted sale price of the home (in US dollars)	7,459	102,968	64,293	4,937	110,166	69,422
SalePrice96	The sale price of the home adjusted to 1996 US dollars	7,459	79,114	47,257	4,937	80,156	48,906
LN_SalePrice96	The natural log transformation of the sale price of the home adjusted to 1996 US dollars	7,459	11.12	0.58	4,937	11.12	0.60
AgeatSale	The age of the home at the time of sale	7,459	46	37	4,937	47	36
AgeatSale_Sqrd	The age of the home at the time of sale squared	7,459	3,491	5,410	4,937	3,506	5,412
Sqft_1000	The number of square feet of above grade finished living area (in 1000s)	7,459	1.623	0.59	4,937	1.628	0.589
Acres	The number of Acres sold with the residence	7,459	1.13	2.42	4,937	1.10	2.40
Baths	The number of Bathrooms (Full Bath = 1, Half Bath = 0.5)	7,459	1.74	0.69	4,937	1.75	0.70
ExtWalls_Stone	If the home has exterior walls of stone, brick or stucco (Yes = 1, No = 0)	2,287	0.31	0.46	1,486	0.30	0.46
CentralAC	If the home has a Central AC unit (Yes = 1, No = 0)	3,785	0.51	0.50	2,575	0.52	0.50
Fireplace	The number of fireplace openings	2,708	0.39	0.55	1,834	0.40	0.55
Cul_De_Sac	If the home is situated on a cul-de-sac (Yes = 1, No = 0)	990	0.13	0.34	673	0.14	0.34
FinBsmt	If finished basement square feet is greater than 50% times first floor square feet (Yes = 1, No = 0)	1,472	0.20	0.40	992	0.20	0.40
Water_Front	If the home shares a property line with a body of water or river (Yes = 1, No = 0)	107	0.01	0.12	87	0.02	0.13
Cnd_Low	If the condition of the home is Poor (Yes = 1, No = 0)	101	0.01	0.12	69	0.01	0.12
Cnd_BAvg	If the condition of the home is Below Average (Yes = 1, No = 0)	519	0.07	0.25	359	0.07	0.26
Cnd_Avg	If the condition of the home is Average (Yes = 1, No = 0)	4,357	0.58	0.49	2,727	0.55	0.50
Cnd_AAvg	If the condition of the home is Above Average (Yes = 1, No = 0)	2,042	0.27	0.45	1,445	0.29	0.46
Cnd_High	If the condition of the home is High (Yes = 1, No = 0)	440	0.06	0.24	337	0.07	0.25
Vista_Poor	If the Scenic Vista from the home is Poor (Yes = 1, No = 0)	470	0.06	0.24	310	0.06	0.24
Vista_BAvg	If the Scenic Vista from the home is Below Average (Yes = 1, No = 0)	4,301	0.58	0.49	2,857	0.58	0.49
Vista_Avg	If the Scenic Vista from the home is Average (Yes = 1, No = 0)	1,912	0.26	0.44	1,247	0.25	0.44
Vista_AAvg	If the Scenic Vista from the home is Above Average (Yes = 1, No = 0)	659	0.09	0.28	448	0.09	0.29
Vista_Prem	If the Scenic Vista from the home is Premium (Yes = 1, No = 0)	117	0.02	0.12	75	0.02	0.12
SaleYear	The year the home was sold	7,459	2002	2.9	4,937	2004	2.3

** "Freq." applies to the number of cases the parameter's value is not zero*

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Table 7: Summary of Variables of Interest: All Sales and Post-Construction Sales

		All Sales			Post Construction Sales		
Variable Name	Description	Freq. *	Mean	Std. Dev.	Freq. *	Mean	Std. Dev.
View_None	If the home sold after construction began and had no view of the turbines (Yes = 1, No = 0)	4,207	0.56	0.50	4,207	0.85	0.36
View_Minor	If the home sold after construction began and had a Minor View of the turbines (Yes = 1, No = 0)	561	0.08	0.26	561	0.11	0.32
View_Mod	If the home sold after construction began and had a Moderate View of the turbines (Yes = 1, No = 0)	106	0.01	0.12	106	0.02	0.15
View_Sub	If the home sold after construction began and had a Substantial View of the turbines (Yes = 1, No = 0)	35	-	0.07	35	0.01	0.08
View_Extrm	If the home sold after construction began and had a Extreme View of the turbines (Yes = 1, No = 0)	28	-	0.06	28	0.01	0.08
DISTANCE †	Distance to nearest turbine if the home sold after facility "announcement", otherwise 0	5,705	2.53	2.59	4,895	3.57	1.68
Mile_Less_0.57 †	If the home sold after facility "announcement" and was within 0.57 miles (3000 feet) of the turbines (Yes = 1, No = 0)	80	0.01	0.09	67	0.01	0.12
Mile_0.57to1 †	If the home sold after facility "announcement" and was between 0.57 miles (3000 feet) and 1 mile of the turbines (Yes = 1, No = 0)	65	0.01	0.09	58	0.01	0.11
Mile_1to3 †	If the home sold after facility "announcement" and was between 1 and 3 miles of the turbines (Yes = 1, No = 0)	2,359	0.27	0.44	2,019	0.41	0.49
Mile_3to5 †	If the home sold after facility "announcement" and was between 3 and 5 miles of the turbines (Yes = 1, No = 0)	2,200	0.26	0.44	1,923	0.39	0.49
Mile_Gtr5 †	If the home sold after facility "announcement" and was outside 5 miles of the turbines (Yes = 1, No = 0)	1,000	0.12	0.32	870	0.18	0.38

** "Freq." applies to the number of cases the parameter's value is not zero*

† "All Sales" freq., mean and standard deviation DISTANCE and DISTANCE fixed effects variables (e.g., Mile_1to3) include transactions that occurred after facility "announcement" and before "construction" as well as those that occured post-construction

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4. Base Hedonic Model

This section uses the primary hedonic model ("Base Model") to assess whether residential sales prices are affected, in a statistically measurable way, by views of and proximity to wind power facilities. In so doing, it simultaneously tests for the presence of the three potential property value stigmas associated with wind power facilities: Area, Scenic Vista, and Nuisance. This section begins with a discussion of the dataset that is used and the form of the model that is estimated, and then turns to the results of the analysis. Various alternative hedonic models are discussed and estimated in Section 5, with Sections 6 and 7 providing a discussion of and results from the repeat sales and sales volume models.

4.1. Dataset

The data used for the Base Model were described in Section 3.3. A key threshold question is whether or not to include the residential transactions that pre-date the relevant wind facility. Specifically, though the complete dataset consists of 7,459 residential transactions, a number of these transactions ($n = 2{,}522$) occurred before the wind facility was constructed. Should these homes which, at the time of sale, would not have had any view of or distance to the wind facility, be included? Two approaches could be applied to address this issue. First, pre-construction transactions could be included in the hedonic model either as part of the reference category within which no wind-project property value impacts are assumed to exist, or instead by specifically identifying these pre-construction transactions through an indicator variable. Second, and alternatively, pre-construction transactions could simply be excluded from the analysis altogether.

For the purpose of the Base Model, the latter approach is used, therefore relying on only the post-construction subset of 4,937 residential transactions. This approach, as compared to the others, results in somewhat more intuitive findings because all homes have a distance greater than zero and have a possibility of some view of the turbines. More importantly, this approach minimizes the chance of inaccuracies that may otherwise exist due to inflation adjustment concerns or outdated home characteristics information.[50] Nonetheless, to test for the implications of this choice of datasets, alternative hedonic models that use the full dataset were estimated, and are discussed in detail in Sections 5.3 and 5.4.

[50] Home characteristics were obtained as of the last property assessment. The timing of that assessment relative to the timing of the home sale transaction dictates how representative the assessed home characteristics are of the subject home when it was sold. For example, if a home sold early in the study period but subsequently had significant improvements made that are reflected in the current assessment data used in the analysis, the model would assign value to these home characteristics at the time of sale when, in fact, those characteristics were inaccurate. Additionally, the inflation adjustment index used in this analysis to translate home values to real 1996 dollars came from the nearest or more appropriate municipal statistical area (MSA). Many of the wind projects in the analysis are located in relatively rural parts of the country, and the housing market in the nearest metropolitan area could be different than the market surrounding wind projects. Although these areas have – in many instances – recently begun to attract home buyers willing to commute back to the metropolitan areas on which the index is based, the older index adjustments are likely less accurate than the more recent adjustments. Using a subset of the data for the majority of the analyses that removes the older, pre-construction, homes minimizes both of these biases.

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4.2. Model Form

A standard semi-log functional form is used for the hedonic models (as was discussed in Section 2.1), where the dependent variable (sales price in inflation-adjusted 1996 dollars) is transformed to its natural log form and the independent variables (e.g., square feet and acres) are not transformed. Using this form to examine the effect that views of, and distance to, wind facilities have on sales prices, the following basic model is estimated:

$$\ln(\mathrm{P}) = \beta_0 + \beta_1 \mathrm{N} + \sum_{\mathrm{s}} \beta_2 \mathrm{S} + \sum_{\mathrm{k}} \beta_3 \mathrm{X} + \sum_{\mathrm{v}} \beta_4 \mathrm{VIEW} + \sum_{\mathrm{d}} \beta_5 \mathrm{DISTANCE} + \varepsilon \quad (1)$$

where
P represents the inflation-adjusted sales price,
N is the spatially weighted neighbors' predicted sales price,
S is the vector of *s* Study Area fixed effects variables (e.g., WAOR, OKCC, etc.),
X is a vector of *k* home and site characteristics (e.g., acres, square feet, number of bathrooms, condition of the home, age of home, VISTA, etc.),
VIEW is a vector of *v* categorical view of turbine variables (e.g., MINOR, MODERATE, etc.),
DISTANCE is a vector of *d* categorical distance to turbine variables (e.g., less than 3000 feet, between one and three miles, etc.),
β_0 is the constant or intercept across the full sample,
β_1 is a parameter estimate for the spatially weighted neighbor's predicted sales price,
β_2 is a vector of *s* parameter estimates for the study area fixed effects as compared to homes sold in the Washington/Oregon (WAOR) study area,
β_3 is a vector of *k* parameter estimates for the home and site characteristics,
β_4 is a vector of *v* parameter estimates for the VIEW variables as compared to homes sold with no view of the turbines,
β_5 is a vector of *d* parameter estimates for the DISTANCE variables as compared to homes sold situated outside of five miles, and
ε is a random disturbance term.

As such, this model, and all subsequent hedonic models, has four primary groups of parameters: variables of interest, spatial adjustments, study-area fixed effects, and home and site characteristics.

The variables of interest, VIEW and DISTANCE, are the focus of this study, and allow the investigation of the presence of Area, Scenic Vista, and Nuisance Stigmas. These variables were defined in Section 3, and are summarized in Table 8. Both VIEW and DISTANCE appear in the model together because a home's value may be affected in part by the magnitude of the view of the wind turbines, and in part by the distance from the home to those turbines, and both variables appear in the Base Model as ordered categorical values. The coefficients associated with these two vectors of variables (β_4 and β_5) represent the marginal impact of views of, and distances to, wind turbines on sales prices, as compared to a "reference" category of residential transactions, and should be ordered monotonically from low to high.[51] This form of variable was used to

[51] "Reference category" refers to the subset of the sample to which other observations are compared, and is pertinent when using categorical or "fixed effect" variables.

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impose the least structure on the underlying data.[52] For the purpose of the Base Model, the reference category for the DISTANCE variables are those transactions of homes that were situated outside of five miles from the nearest wind turbine. The reference category for the VIEW variables are those transactions of homes that did not have a view of the wind facility upon sale. Among the post-construction sample of homes, these reference homes are considered the least likely to be affected by the presence of the wind facilities.[53]

Table 8: List of Variables of Interest Included in the Base Model

Variable Name	Description	Type	Expected Sign
View_None	If the home sold after construction began and had no view of the turbines (Yes = 1, No = 0)	Reference	n/a
View_Minor	If the home sold after construction began and had a Minor View of the turbines (Yes = 1, No = 0)	OC	-
View_Mod	If the home sold after construction began and had a Moderate View of the turbines (Yes = 1, No = 0)	OC	-
View_Sub	If the home sold after construction began and had a Substantial View of the turbines (Yes = 1, No = 0)	OC	-
View_Extrm	If the home sold after construction began and had an Extreme View of the turbines (Yes = 1, No = 0)	OC	-
Mile_Less_0.57	If the home sold after facility "construction" and was within 0.57 miles (3000 feet) of the turbines (Yes = 1, No = 0)	OC	-
Mile_0.57to1	If the home sold after facility "construction" and was between 0.57 miles (3000 feet) and 1 mile of the turbines (Yes = 1, No = 0)	OC	-
Mile_1to3	If the home sold after facility "construction" and was between 1 and 3 miles of the turbines (Yes = 1, No = 0)	OC	-
Mile_3to5	If the home sold after facility "construction" and was between 3 and 5 miles of the turbines (Yes = 1, No = 0)	OC	-
Mile_Gtr5	If the home sold after facility "construction" and was outside 5 miles of the turbines (Yes = 1, No = 0)	Reference	n/a

"OC" Ordered Categorical (1 = yes, 0 = no) values are interpreted in relation to the reference categorical case and are expected to have a monotonic order from low to high.

The three stigmas are investigated though these VIEW and DISTANCE variables. Scenic Vista Stigma is investigated through the VIEW variables. Area and Nuisance Stigmas, on the other hand, are investigated through the DISTANCE variables. To distinguish between Area and

[52] In place of the ordered categorical DISTANCE variables, practitioners often rely on a continuous DISTANCE form (e.g., Sims et al., 2008). Similar to ordered categorical variables, continuous variables have a natural ordering, either ascending or descending, but, unlike categorical variables, these "continuous" values are on a scale. Therefore, given any two of its values X_1 and X_2 and a specific functional form, the ratio "X_1/X_2" and the distance "$X_1 - X_2$" have a fixed meaning. Examples of continuous variables other than DISTANCE that are commonly used include the number of square feet of living area (in 1000s) in a home (SQFT_1000) or the acres in the parcel (ACRES). A continuous functional form of this nature "imposes structure" because practitioners must decide how price is related to the underlying variables through the selection of a specific functional relationship between the two. For instance, in the case of DISTANCE, is there a linear relationship (which would imply a similar marginal difference between two distances both near and far from the turbines), does it decay slowly as distance grows, or does it fade completely at some fixed distance? Because of the lack of literature in this area, no *a priori* expectations for which functional form is the best were established, and therefore unstructured categorical variables are used in the Base Model. Nonetheless, a continuous DISTANCE form is explored in Section 5.2.

[53] It is worth noting that these reference homes are situated in both rural and urban locales and therefore are not uniquely affected by influences from either setting. This further reinforces their worthiness as a reference category.

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Nuisance Stigma, it is assumed that Nuisance effects are concentrated within one mile of the nearest wind turbine, while Area effects will be considered for those transactions outside of one mile. Any property value effects discovered outside of one mile and based on the DISTANCE variables are therefore assumed to indicate the presence of Area Stigma, while impacts within a mile may reflect the combination of Nuisance and Area Stigma.

The second set of variables in the Base Model - spatial adjustments - correct for the assumed presence of spatial autocorrelation in the error term (ε). It is well known that the sales price of a home can be systematically influenced by the sales prices of those homes that have sold nearby. Both the seller and the buyer use information from comparable surrounding sales to inform them of the appropriate transaction price, and nearby homes often experience similar amenities and disamenities. This lack of independence of home sale prices could bias hedonic regression results and, to help correct for this bias, a spatially (i.e., distance) weighted neighbors' sales price (N) is included in the model. Empirically, the neighbors' price has been found to be a strong (and sometimes even the strongest) predictor of home values (Leonard and Murdoch, forthcoming), and the coefficient β_1 is expected to be positive, indicating a positive correlation between the neighbors' and subject home's sales price. A more-detailed discussion of the importance of this variable, and how it was created, is contained in Appendix G.

The third group of variables in the Base Model - study area fixed effects - control for study area influences and the differences between them. The vector's parameters β_2 represent the marginal impact of being in any one of the study areas, as compared to a reference category. In this case, the reference category is the Washington/Oregon (WAOR) study area.[54] The estimated coefficients for this group of variables represent the combined effects of school districts, tax rates, crime, and other locational influences across an entire study area. Although this approach greatly simplifies the estimation of the model, because of the myriad of influences captured by these study-area fixed effects variables, interpreting the coefficient can be difficult. In general, though, the coefficients simply represent the mean difference in sales prices between the study areas and the reference study area (WAOR). These coefficients are expected to be strongly influential, indicating significant differences in sales prices across study areas.

The fourth group of variables in the Base Model are the core home and site characteristics (X), and include a range of continuous ("C"),[55] discrete ("D"),[56] binary ("B"),[57] and ordered categorical ("OC") variables. The specific home and site variables included in the Base Model are listed in Table 9 along with the direction of expected influence.[58] Variables included are age

[54] Because there is no intent to focus on the coefficients of the study area fixed effect variables, the reference case is arbitrary. Further, the results for the other variables in the model are completely independent of this choice.

[55] See discussion in footnote 52 on previous page.

[56] Discrete variables, similar to continuous variables, are ordered and the distance between the values, such as X_1 and X_2, have meaning, but for these variables, there are only a relatively small number of discrete values that the variable can take, for example, the number of bathrooms in a home (BATHROOMS).

[57] Binary variables have only two conditions: "on" or "off" (i.e., "1" or "0" respectively). Examples are whether the home has central air conditioning ("CENTRAL_AC") or if the home is situated on a cul-de-sac ("CUL_DE_SAC"). The coefficients for these variables are interpreted in relation to when the condition is "off."

[58] For those variables with a "+" sign it is expected that as the variable increases in value (or is valued at "1" as would be the case for fixed effects variables) the price of the home will increase, and the converse is true for the variables with a "-" sign. The expected signs of the variables all follow conventional wisdom (as discussed in

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of the home, home and lot size, number of bathrooms and fireplaces, the condition of the home, the quality of the scenic vista from the home, if the home has central AC, a stone exterior, and/or a finished basement, and whether the home is located in a cul-de-sac and/or on a water way.[59]

Table 9: List of Home and Site Characteristics Included in the Base Model

Variable Name	Description	Type	Expected Sign
AgeatSale	The age of the home at the time of sale in years	C	-
AgeatSale_Sqrd	The age of the home at the time of sale squared	C	+
Sqft_1000	The number of square feet of above grade finished living area (in 1000s)	C	+
Acres	The number of Acres sold with the residence	C	+
Baths	The number of Bathrooms (Full Bath = 1, Half Bath = 0.5)	D	+
ExtWalls_Stone	If the home has exterior walls of stone, brick or stucco (Yes = 1, No = 0)	B	+
CentralAC	If the home has a Central AC unit (Yes = 1, No = 0)	B	+
Fireplace	The number of fireplace openings	D	+
Cul_De_Sac	If the home is situated on a cul-de-sac (Yes = 1, No = 0)	B	+
FinBsmt	If finished basement sqft > 50% times first floor sqft (Yes = 1, No = 0)	B	+
Water_Front	If the home shares a property line with a body of water or river (Yes = 1, No = 0)	B	+
Cnd_Low	If the condition of the home is Poor (Yes = 1, No = 0)	OC	-
Cnd_BAvg	If the condition of the home is Below Average (Yes = 1, No = 0)	OC	-
Cnd_Avg	If the condition of the home is Average (Yes = 1, No = 0)	Reference	n/a
Cnd_AAvg	If the condition of the home is Above Average (Yes = 1, No = 0)	OC	+
Cnd_High	If the condition of the home is High (Yes = 1, No = 0)	OC	+
Vista_Poor	If the Scenic Vista from the home is Poor (Yes = 1, No = 0)	OC	-
Vista_BAvg	If the Scenic Vista from the home is Below Average (Yes = 1, No = 0)	OC	-
Vista_Avg	If the Scenic Vista from the home is Average (Yes = 1, No = 0)	Reference	n/a
Vista_AAvg	If the Scenic Vista from the home is Above Average (Yes = 1, No = 0)	OC	+
Vista_Prem	If the Scenic Vista from the home is Premium (Yes = 1, No = 0)	OC	+

"C" Continuous, "D" Discrete, and "B" Binary (1 = yes, 0 = no) values are interpreted in relation to "No"

"OC" Ordered Categorical (1 = yes, 0 = no) values are interpreted in relation to the reference categorical case and are expected to have a monotonic order from low to high.

Sirmans et al., 2005a), save AgeatSale and AgeatSale_Sqrd, which are expected to be negative and positive, respectively. The magnitude of the coefficient of AgeatSale is expected to be larger than that of AgeatSale_Sqrd indicating an initial drop in value as a home increases in age, and then an increase in value as the home becomes considerably older and more "historic."

[59] Some characteristics, such as whether the home had a deck, a pool, or is located on a public sewer, are not available consistently across the dataset and therefore are not incorporated into the model. Other characteristics, such as the number of bedrooms, the number of stories, or if the home had a garage, are available but are omitted from the final model because they are highly correlated with characteristics already included in the model and therefore do not add significantly to the model's explanatory power. More importantly, and as discussed in Appendix G, when their inclusion or exclusion are tested, the results are stable with those derived from the Base Model.

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It should be emphasized that in the Base Hedonic Model - equation (1) - and in all subsequent models presented in Section 5, all variables of interest, spatial adjustments, and home and site characteristics are pooled, and therefore their estimates represent the average across all study areas. Ideally, one would have enough data to estimate a model at the study area level - a fully unrestricted model - rather than pooled across all areas. This fully unrestricted model form, along with 15 other model forms (with some variables restricted and others not), are discussed in detail in Appendix F. In total, these 16 different models were estimated to explore which model was the most parsimonious (had the fewest parameters), performed the best (e.g., had the highest adjusted R^2 and the lowest Schwarz information criterion[60]), and had the most stable coefficients and standard errors. The basic pooled model described by equation (1) is found to fit that description, and that model is therefore chosen as the Base Model to which others are compared. By making this choice the effort concentrates on identifying the presence of potential property value impacts across all of the study areas in the sample as opposed to any single study area.[61]

Finally, to assure that the model produces the best linear unbiased parameter estimates, the underlying assumptions of Ordinary Least Squares (OLS) regression techniques must be verified:

1) Homoskedastic error term;
2) Absence of temporal serial correlation;
3) Reasonably limited multicollinearity; and
4) Appropriate controls for outliers and influencers.[62]

These assumptions, and the specific approaches that are used to address them, are discussed in detail in Appendix G.

4.3. Analysis of Results

Table 10 (on page 32) presents the results of the Base Model (equation 1).[63] The model performs well, with an adjusted R^2 of 0.77.[64] The spatial adjustment coefficient (β_1) of 0.29 (*p* value 0.00) indicates that a 10% increase in the spatially weighted neighbor's price increases the subject home's value by an average of 2.9%. The study-area fixed effects (β_2) variables are all significant at the one percent level, demonstrating important differences in home valuations

[60] The Schwarz information criterion measures relative parsimony between similar models (Schwarz, 1978).

[61] Because effects might vary between study areas, and the models estimate an average across all study areas, the full range of effects in individual study areas will go undetermined. That notwithstanding, there is no reason to suspect that effects will be completely "washed out." For that to occur, an effect in one study area would have to be positive while in another area it would have to be negative, and there is no reason to suspect that sales prices would increase because of the turbines in one community while decreasing in other communities.

[62] The absence of spatial autocorrelation is often included in the group of assumptions, but because it was discussed above (and in Appendix G), and is addressed directly by the variable (N_i) included in the model, it is not included in this list.

[63] This model and all subsequent models were estimated using the PROC REG procedure of SAS Version 9.2 TS1M0, which produces White's corrected standard errors.

[64] The appropriateness of the R^2 of 0.77 for this research is validated by the extensive hedonic literature that precedes it (see e.g., Kroll and Priestley, 1992; Boyle and Kiel, 2001; Simons, 2006b).

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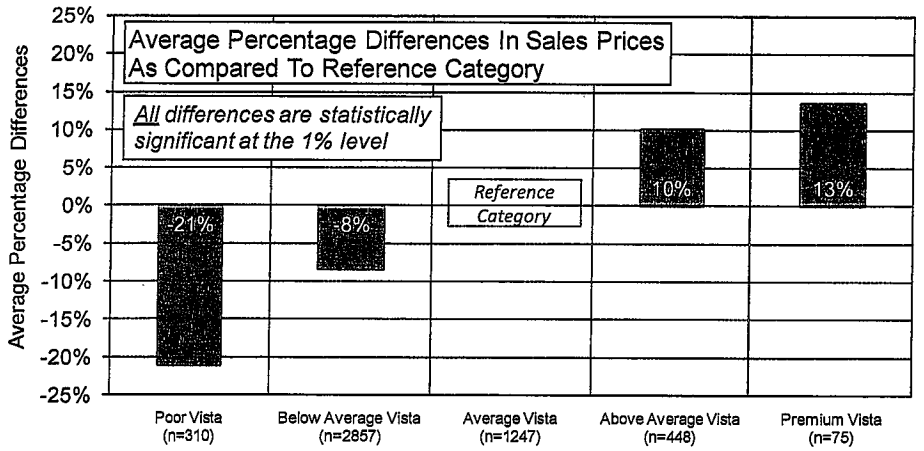
between the reference study area (WAOR) and the other nine study areas.[65] The sign and magnitudes of the home and site characteristics are all appropriate given the *a priori* expectations, and all are statistically significant at the one percent level.[66]

Of particular interest are the coefficient estimates for scenic vista (VISTA) as shown in Figure 5. Homes with a POOR vista rating are found, on average, to sell for 21% less (p value 0.00) than homes with an AVERAGE rating, while BELOW AVERAGE homes sell for 8% less (p value 0.00). Conversely, homes with an ABOVE AVERAGE vista are found to sell for 10% more (p value 0.00) than homes with an AVERAGE vista, while PREMIUM vista homes sell for 13% more than AVERAGE homes (p value 0.00). Based on these results, it is evident that home buyers and sellers capitalize the quality of the scenic vista in sales prices.[67]

Figure 5: Results from the Base Model for VISTA



The reference category consists of transactions for homes with an Average Vista, and that occured after construction began on the wind facility

[65] The reference category WAOR study area has the highest mean and median house values in the sample (as shown in Appendix A) so the negative coefficients for all the study area fixed effect variables are appropriate.

[66] To benchmark the results against those of other practitioners the research by Sirmans et al. (2005a; 2005b) was consulted. They conducted a meta-analysis of 64 hedonic studies carried out in multiple locations in the U.S. during multiple time periods, and investigated the coefficients of ten commonly used characteristics, seven of which were included in the model. The similarities between their mean coefficients (i.e., the average across all 64 studies) and those estimated in the present Base Model are striking. The analysis presented here estimates the effect of square feet (in 1000s) on log of sales price at 0.28 and Sirmans et al. provide an estimate of 0.34, while ACRES was similarly estimated (0.02 to 0.03, Base Model and Sirmans et al., respectively). Further, AGEATSALE (age at the time of sale) (-0.006 to -0.009), BATHROOMS (0.09 to 0.09), CENTRALAC (0.09 to 0.08), and FIREPLACE (0.11 to 0.09) all similarly compare. As a group, the Base Model estimates differ from Sirmans et al. estimates in all cases by no more than a third of the Sirmans et al. mean estimate's standard deviation. This, taken with the relatively high adjusted R^2 of the Base Model, demonstrates the appropriateness of the model's specification.

[67] To benchmark these results they are compared to the few studies that have investigated the contribution of inland scenic vistas to sales prices. Benson et al. (2000) find that a mountain vista increases sales price by 8%, while Bourassa et al. (2004) find that wide inland vistas increase sales price by 7.6%. These both compare favorably to the 10% and 14% above average and premium rated VISTA estimates. Comparable studies for below average and poor VISTA were not found and therefore no benchmarking of those coefficients is conducted. Finally, it should again be noted that a home's scenic vista, as discussed in Section 3.2.3, was ranked without taking the presence of the wind turbines into consideration, even if those turbines were visible at the time of home sale.

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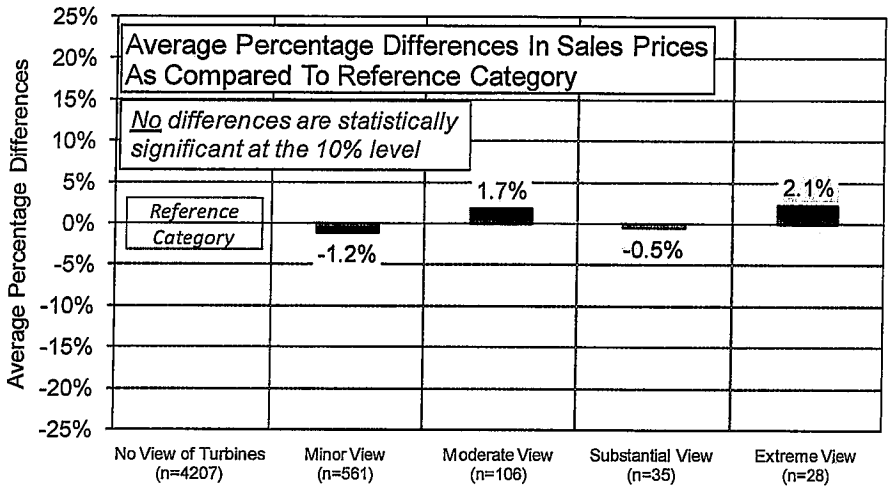
Despite this finding for scenic vista, however, no statistically significant relationship is found between views of wind turbines and sales prices.[68] The coefficients for the VIEW parameters (β_4) are all relatively small, none are statistically significant, and they are not monotonically ordered (see Figure 6). Homes with EXTREME or SUBSTANTIAL view ratings, for which the Base Model is expected to find the largest differences, sell for, on average, 2.1% more (p value 0.80) and 0.5% less (p value 0.94) than NO VIEW homes that sold in the same post-construction period. Similarly, homes with MODERATE or MINOR view ratings sell, on average, for 1.7% more (p value 0.58) and 1.2% less (p value 0.40) than NO VIEW homes, respectively. None of these coefficients are sizable, and none are statistically different from zero. These results indicate that, among this sample at least, a statistically significant relationship between views of wind turbines and residential property values is not evident. In other words, there is an absence of evidence of a Scenic Vista Stigma in the Base Model.

Figure 6: Results from the Base Model for VIEW



The reference category consists of transactions for homes without a view of the turbines, and that occured after construction began on the wind facility

The coefficients for the DISTANCE parameters (β_5) are also all relatively small and none are statistically significant (see Figure 7). Homes that are situated within 3000 feet (0.57 miles) of the nearest wind turbine, at the time of sale, are found to sell for 5.3% less (p value 0.40), on average, than homes outside of 5 miles that sold in the same "post-construction" period. Meanwhile, homes between 3000 feet and 1 mile sold for 5.5% less (p value 0.30), on average, than homes more than 5 miles away. Homes that are within 1 to 3 miles of the nearest turbine, as compared to homes outside of 5 miles, sold for essentially the same, on average (coefficient = 0.004, p value 0.80), while homes between 3 and 5 miles sold for 1.6% more (p value 0.23).

[68] A significance level of 10% is used throughout this report, which corresponds to a p-value at or above 0.10. Although this is more liberal than the often used 5% (p-value at or above 0.05), it was chosen to give more opportunities for effects that might be fairly weak to be considered significant.

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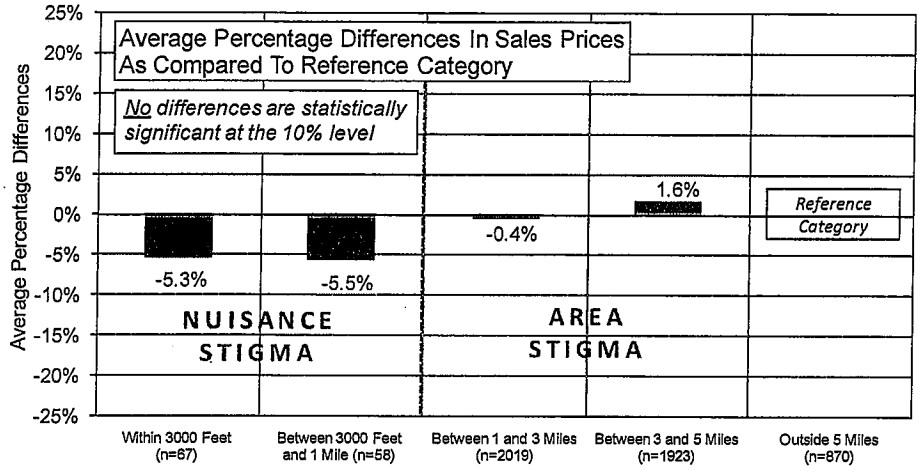
Figure 7: Results from the Base Model for DISTANCE



The reference category consists of transactions for homes situated more than five miles from the nearest turbine, and that occured after construction began on the wind facility

Looking at these results as a whole, a somewhat monotonic order from low to high is found as homes are situated further away from wind facilities, but all of the coefficients are relatively small and none are statistically different from zero. This suggests that, for homes in the sample at least, there is a lack of statistical evidence that the distance from a home to the nearest wind turbine impacts sales prices, and this is true regardless of the distance band.[69] As such, an absence of evidence of an Area or Nuisance Stigma is found in the Base Model. That notwithstanding, the -5% coefficients for homes that sold within one mile of the nearest wind turbine require further scrutiny. Even though the differences are not found to be statistically significant, they might point to effects that exist but are too small for the model to deem statistically significant due to the relatively small number of homes in the sample within 1 mile of the nearest turbine. Alternatively, these homes may simply have been devalued even before the wind facility was erected, and that devaluation may have carried over into the post construction period (the period investigated by the Base Model). To explore these possibilities, transactions that occurred well before the announcement of the wind facility to well after construction are investigated in the Temporal Aspects Model in the following "Alternative Models" section.

[69] It is worth noting that the number of cases in each of these categories (e.g., $n = 67$ for homes inside of 3000 feet and $n = 58$ between 3000 feet and one mile) are small, but are similar to the numbers of cases for other variables in the same model (e.g., LOW CONDITION, $n = 69$; PREMIUM VISTA, $n = 75$), the estimates of which were found to be significant above the 1% level.

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Table 10: Results from the Base Model

	Coef.	SE	p Value	*n*
Intercept	7.62	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.33	0.04	0.00	87
Cnd_Low	-0.45	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.14	0.01	0.00	1,445
Cnd_High	0.23	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.03	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.24	0.02	0.00	605
ILLC	-0.09	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.07	0.03	0.01	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
Post_Con_NoView	Omitted	Omitted	Omitted	4,207
View_Minor	-0.01	0.01	0.40	561
View_Mod	0.02	0.03	0.58	106
View_Sub	-0.01	0.07	0.94	35
View_Extrm	0.02	0.09	0.80	28
Mile_Less_0_57	-0.05	0.06	0.40	67
Mile_0_57to1	-0.05	0.05	0.30	58
Mile_1to3	0.00	0.02	0.80	2,019
Mile_3to5	0.02	0.01	0.23	1,923
Mile_Gtr5	Omitted	Omitted	Omitted	870

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	1
Dependent Variable	LN_SalePrice96
Number of Cases	4937
Number of Predictors (k)	37
F Statistic	442.8
Adjusted R Squared	0.77

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5. Alternative Hedonic Models

The Base Hedonic Model presented in Section 4 found that residential property values have, on average, not been measurably affected by the presence of nearby wind facilities. To test the robustness of this result and to test for other possible impacts from nearby wind projects, the report now turns to a number of other hedonic models. These Alternative Models were created to investigate different approaches to exploring the impact of the variables of interest (#1 and #2, below) and to assess the presence of impacts that are not otherwise fully captured by the Base Model (#3 through #6, below).

1) **View and Distance Stability Models:** Using only post-construction transactions (the same as the Base Model) these models investigate whether the Scenic Vista Stigma (as measured with VIEW) results are independent of the Nuisance and Area Stigma results (as measured by DISTANCE) and vice versa.[70]
2) **Continuous Distance Model:** Using only post-construction transactions, this model investigates Area and Nuisance Stigmas by applying a continuous distance parameter as opposed to the categorical variables for distance used in the previous models.
3) **All Sales Model:** Using all transactions, this model investigates whether the results for the three stigmas change if transactions that occurred before the announcement and construction of the wind facility are included in the sample.
4) **Temporal Aspects Model:** Using all transactions, this model further investigates Area and Nuisance Stigmas and how they change for homes that sold more than two years pre-announcement through the period more than four years post-construction.
5) **Home Orientation Model:** Using only post-construction transactions, this model investigates the degree to which a home's orientation to the view of wind turbines affects sales prices.
6) **View and Vista Overlap Model:** Using only post-construction transactions, this model investigates the degree to which the overlap between the view of a wind facility and a home's primary scenic vista affects sales prices.

Each of these models is described in more depth in the pages that follow. Results are shown for the variables of interest only; full results are contained in Appendix H.

5.1. View and Distance Stability Models

The Base Model (equation 1) presented in Section 4 includes both DISTANCE and VIEW variables because a home's value might be affected in part by the magnitude of the view of a nearby wind facility and in part by the distance from the home to that facility. These two variables may be related, however, in-so-far as homes that are located closer to a wind facility are likely to have a more-dominating view of that facility. To explore the degree to which these two sets of variables are independent of each other (i.e. not collinear) and to further test the robustness of the Base Model results two alternative hedonic models are run, each of which includes only one of the sets of parameters (DISTANCE or VIEW). Coefficients from these models are then compared to the Base Model results.

[70] Recall that the qualitative VIEW variable incorporated the visible distance to the nearest wind facility.

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5.1.1. Dataset and Model Form

The same dataset is used as in the Base Model, focusing again on post-construction transactions (n = 4,937). To investigate DISTANCE effects alone the following model is estimated:

$$\ln(\mathrm{P}) = \beta_0 + \beta_1 \mathrm{N} + \sum_{\mathrm{s}} \beta_2 \mathrm{S} + \sum_{\mathrm{k}} \beta_3 \mathrm{X} + \sum_{\mathrm{d}} \beta_5 \mathrm{DISTANCE} + \varepsilon \quad (2)$$

where
P represents the inflation-adjusted sales price,
N is the spatially weighted neighbors' predicted sales price,
S is the vector of s Study Area fixed effects variables (e.g., WAOR, OKCC, etc.),
X is a vector of k home and site characteristics (e.g., acres, square feet, number of bathrooms, condition of the home, age of home, VISTA, etc.),
DISTANCE is a vector of d categorical distance variables (e.g., less than 3000 feet, between one and three miles, etc.),
β_0 is the constant or intercept across the full sample,
β_1 is a parameter estimate for the spatially weighted neighbor's predicted sales price,
β_2 is a vector of s parameter estimates for the study area fixed effects as compared to transactions of homes in the WAOR study area,
β_3 is a vector of k parameter estimates for the home and site characteristics,
β_5 is a vector of d parameter estimates for the DISTANCE variables as compared to transactions of homes situated outside of five miles, and
ε is a random disturbance term.

The parameters of primary interest are β_5, which represent the marginal differences between home values at various distances from the wind turbines as compared to the reference category of homes outside of five miles. These coefficients can then be compared to the same coefficients estimated from the Base Model.

Alternatively, to investigate the VIEW effects alone, the following model is estimated:

$$\ln(\mathrm{P}) = \beta_0 + \beta_1 \mathrm{N} + \sum_{\mathrm{s}} \beta_2 \mathrm{S} + \sum_{\mathrm{k}} \beta_3 \mathrm{X} + \sum_{\mathrm{v}} \beta_4 \mathrm{VIEW} + \varepsilon \quad (3)$$

where
VIEW is a vector of v categorical view variables (e.g., MINOR, MODERATE, etc.),
β_4 is a vector of v parameter estimates for the VIEW variables, and
all other components are as defined in equation (2).

The parameters of primary interest in this model are β_4, which represent the marginal differences between home values for homes with varying views of wind turbines at the time of sale as compared to the reference category of homes without a view of those turbines. Again, these coefficients can then be compared to the same coefficients estimated from the Base Model.

Our expectation for both of the models described here is that the results will not be dramatically different from the Base Model, given the distribution of VIEW values across the DISTANCE values, and vice versa, as shown in Table 11. Except for EXTREME view, which is

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concentrated inside of 3000 feet, all view ratings are adequately distributed among the distance categories.

Table 11: Frequency Crosstab of VIEW and DISTANCE Parameters

	Inside 3000 Feet	Between 3000 Feet and 1 Mile	Between 1 and 3 Miles	Between 3 and 5 Miles	Outside 5 Miles	Total
No View	6	12	1653	1695	841	4207
Minor View	14	24	294	202	27	561
Moderate View	8	13	62	21	2	106
Substantial View	11	9	10	5	0	35
Extreme View	28	0	0	0	0	28
TOTAL	67	58	2019	1923	870	4937

5.1.2. Analysis of Results

Summarized results for the variables of interest from the Base Model and the two Alternative Stability Models are presented in Table 12. (For brevity, the full set of results for the models is not shown in Table 12, but is instead included in Appendix H.) The adjusted R^2 for the View and Distance Stability Models is the same as for the Base Model, 0.77. All study area, spatial adjustment, and home and site characteristics are significant at or above the one percent level and are similar in magnitude to the estimates presented earlier for the Base Model.

The DISTANCE and VIEW coefficients, β_5 and β_4, are stable, changing no more than 3%, with most (7 out of 8) not experiencing a change greater than 1%. In all cases, changes to coefficient estimates for the variables of interest are considerably less than the standard errors. Based on these results, there is confidence that the correlation between the VIEW and DISTANCE variables is not responsible for the findings and that these two variables are adequately independent to be included in the same hedonic model regression. As importantly, no evidence of Area, Scenic Vista, or Nuisance Stigma is found in the sample, as none of the VIEW or DISTANCE variables are found to be statistically different from zero.

Table 12: Results from Distance and View Stability Models

		Base Model			Distance Stability			View Stability		
Variables of Interest	*n*	Coef	SE	p Value	Coef	SE	p Value	Coef	SE	p Value
No View	4207	Omitted	Omitted	Omitted				Omitted	Omitted	Omitted
Minor View	561	-0.01	0.01	0.39				-0.02	0.01	0.24
Moderate View	106	0.02	0.03	0.57				0.00	0.03	0.90
Substantial View	35	-0.01	0.07	0.92				-0.04	0.06	0.45
Extreme View	28	0.02	0.09	0.77				-0.03	0.06	0.58
Inside 3000 Feet	67	-0.05	0.06	0.31	-0.04	0.04	0.25			
Between 3000 Feet and 1 Mile	58	-0.05	0.05	0.20	-0.06	0.05	0.17			
Between 1 and 3 Miles	2019	0.00	0.02	0.80	-0.01	0.02	0.71			
Between 3 and 5 Miles	1923	0.02	0.01	0.26	0.01	0.01	0.30			
Outside 5 Miles	870	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted			

"Omitted" = reference category for fixed effects variables. "n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	1	2	3
Dependent Variable	LN_SalePrice96	LN_SalePrice96	LN_SalePrice96
Number of Cases	4937	4937	4937
Number of Predictors (k)	37	33	33
F Statistic	442.8	496.7	495.9
Adjusted R Squared	0.77	0.77	0.77

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5.2. Continuous Distance Model

The potential impact of wind facilities on residential property values based on Area and Nuisance effects was explored with the Base Model by using five ordered categorical DISTANCE variables. This approach was used in order to impose the least restriction on the functional relationship between distance and property values (as discussed in footnote 52 on page 25). The literature on environmental disamenities, however, more commonly uses a continuous distance form (e.g., Sims et al., 2008), which imposes more structure on this relationship. To be consistent with the literature and to test if a more rigid structural relationship might uncover an effect that is not otherwise apparent with the five distance categories used in the Base Model, a hedonic model that relies upon a continuous distance variable is presented here. One important benefit of this model is that a larger amount of data (e.g., $n = 4{,}937$) is used to estimate the continuous DISTANCE coefficient then was used to estimate any of the individual categorical estimates in the Base Model (e.g., $n = 67$ inside 3000 feet, $n = 2019$ between one and three miles). The Continuous Distance Model therefore provides an important robustness test to the Base Model results.

5.2.1. Dataset and Model Form

A number of different functional forms can be used for a continuous DISTANCE variable, including linear, inverse, cubic, quadratic, and logarithmic. Of the forms that are considered, an inverse function seemed most appropriate.[71] Inverse functions are used when it is assumed that any effect is most pronounced near the disamenity and that those effects fade asymptotically as distance increases. This form has been used previously in the literature (e.g., Leonard et al., 2008) to explore the impact of disamenities on home values, and is calculated as follows:

$$\text{InvDISTANCE} = 1/\text{DISTANCE} \tag{4}$$

where
DISTANCE is the distances to the nearest turbine from each home as calculated at the time of sale for homes that sold in the post-construction period.

For the purpose of the Continuous Distance Model, the same dataset is used as in the Base Model, focusing again on post-construction transactions ($n = 4{,}937$). InvDISTANCE has a maximum of 6.67 (corresponding to homes that were 0.15 miles, or roughly 800 feet, from the nearest wind turbine), a minimum of 0.09 (corresponding to a distance of roughly 11 miles), and a mean of 0.38 (corresponding to a distance of 2.6 miles). This function was then introduced into the hedonic model in place of the DISTANCE categorical variables as follows:

$$\ln(\text{P}) = \beta_0 + \beta_1\text{N} + \sum_{\text{s}}\beta_2\text{S} + \sum_{\text{k}}\beta_3\text{X} + \sum_{\text{v}}\beta_4\text{VIEW} + \beta_5\text{InvDISTANCE} + \varepsilon \tag{5}$$

where
InvDISTANCE_i is the inverse of the distance to the nearest turbine,
β_5 is a parameter estimate for the inverse of the distance to the nearest turbine, and

[71] The other distance functions (e.g., linear, quadratic, cubic & logarithmic) were also tested. Additionally, two-part functions with interactions between continuous forms (e.g., linear) and categorical (e.g., less than one mile) were investigated. Results from these models are briefly discussed below in footnote 72.

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all other components are as defined in equation (1).

The coefficient of interest in this model is β_5, which, if effects exist, would be expected to be negative, indicating an adverse effect from proximity to the wind turbines.

5.2.2. Analysis of Results

Results for the variables of interest in the Continuous Distance Model and the Base Model are shown in Table 13. (For brevity, the full set of results for the model is not shown in Table 13, but is instead included in Appendix H.) The model performs well with an adjusted R^2 of 0.77. All study area, spatial adjustment, and home and site characteristics are significant at the one percent level. The coefficients for VIEW are similar to those found in the Base Model, demonstrating stability in results, and none are statistically significant. These results support the previous findings of a lack of evidence of a Scenic Vista Stigma.

Our focus variable InvDISTANCE produces a coefficient (β_5) that is slightly negative at -1%, but that is not statistically different from zero (*p* value 0.41), implying again that there is no statistical evidence of a Nuisance Stigma effect nor an Area Stigma effect and confirming the results obtained in the Base Model.[72]

Table 13: Results from Continuous Distance Model

	Base Model				Continuous Distance			
Variables of Interest	**Coef**	**SE**	**p Value**	***n***	**Coef**	**SE**	**p Value**	***n***
No View	Omitted	Omitted	Omitted	4,207	Omitted	Omitted	Omitted	4,207
Minor View	-0.01	0.01	0.39	561	-0.01	0.01	0.32	561
Moderate View	0.02	0.03	0.57	106	0.01	0.03	0.77	106
Substantial View	-0.01	0.07	0.92	35	-0.02	0.07	0.64	35
Extreme View	0.02	0.09	0.77	28	0.01	0.10	0.85	28
Inside 3000 Feet	-0.05	0.06	0.31	67				
Between 3000 Feet and 1 Mile	-0.05	0.05	0.20	58				
Between 1 and 3 Miles	0.00	0.02	0.80	2,019				
Between 3 and 5 Miles	0.02	0.01	0.26	1,923				
Outside 5 Miles	Omitted	Omitted	Omitted	870				
InvDISTANCE					-0.01	0.02	0.41	4,937

"Omitted" = reference category for fixed effects variables. "n" = number of cases in category when category = "1"

Model Information

Model Equation Number	1	5
Dependent Variable	LN_SalePrice96	LN_SalePrice96
Number of Cases	4937	4937
Number of Predictors (k)	37	34
F Statistic	442.8	481.3
Adjusted R Squared	0.77	0.77

5.3. All Sales Model

The Base Model presented earlier relied on only those transactions that occurred after the construction of the relevant wind facility. This approach, however, leaves open two key questions. First, it is possible that the property values of all of the post-construction homes in the

[72] As mentioned in footnote 71 on page 36, a number of alternative forms of the continuous distance function were also explored, including two-part functions, with no change in the results presented here. In all cases the resulting continuous distance function was not statistically significant.

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sample have been affected by the presence of a wind facility, and therefore that the reference homes in the Base Model (i.e., those homes outside of five miles with no view of a wind turbine) are an inappropriate comparison group because they too have been impacted.[73] Using only those homes that sold before the announcement of the wind facility (pre-announcement) as the reference group would, arguably, make for a better comparison because the sales price of those homes are not plausibly impacted by the presence of the wind facility.[74] Second, the Base Model does not consider homes that sold in the post-announcement but pre-construction period, and previous research suggests that property value effects might be very strong during this period, during which an assessment of actual impacts is not possible and buyers and sellers may take a more-protective and conservative stance (Wolsink, 1989). This subsection therefore presents the results of a hedonic model that uses the full set of transactions in the dataset, pre- and post-construction.

5.3.1. Dataset and Model Form

Unlike the Base Model, in this instance the full set of 7,459 residential transactions is included. The following model is then estimated:

$$\ln(P) = \beta_0 + \beta_1 N + \sum_s \beta_2 S + \sum_k \beta_3 X + \sum_v \beta_4 VIEW + \sum_d \beta_5 DISTANCE + \varepsilon \quad (6)$$

where
VIEW is a vector of v categorical view variables (e.g., NONE, MINOR, MODERATE, etc.),
DISTANCE is a vector of d categorical distance variables (e.g., less than 3000 feet, between one and three miles, outside of five mile, etc.),
β_4 is a vector of v parameter estimates for the VIEW variables as compared to pre-construction transactions,
β_5 is a vector of d parameter estimates for the DISTANCE variables as compared to pre-announcement transactions, and
all other components are as defined in equation (1).

It is important to emphasize that the VIEW and DISTANCE parameters in equation (6) have different reference categories than they do in the Base Model - equation (1). In the Base Model, DISTANCE and VIEW are estimated in the post-construction period in reference to homes that sold outside of five miles and with no view of the turbines respectively.[75] In the All Sales Model, on the other hand, the coefficients for VIEW (β_4) are estimated in reference to all pre-construction transactions (spanning the pre-announcement and post-announcement-pre-construction periods) and the coefficients for DISTANCE (β_5) are estimated in reference to all pre-announcement transactions. In making a distinction between the reference categories for VIEW and DISTANCE, it is assumed that awareness of the view of turbines and awareness of

[73] This might be the case if there is an Area Stigma that includes the reference homes.

[74] As discussed in footnote 47 on page 19, it is conceivable that awareness might occur prior to the "announcement" date used for this analysis. If true, this bias is likely to be sporadic in nature and less of an issue in this model, when all pre-announcement transactions are pooled (e.g., both transactions near and far away from where the turbines were eventually located) than in models presented later (e.g., temporal aspects model). Nonetheless, if present, this bias may weakly draw down the pre-announcement reference category.

[75] See Section 4.1 and also footnote 51 on page 24 for more information on why the post-construction dataset and five-mile-no-view homes reference category are used in the Base Model.

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the distance from them might not occur at the same point in the development process. Specifically, it is assumed that VIEW effects largely occur after the turbines are erected, in the post-construction period, but that DISTANCE effects might occur in the post-announcement-pre-construction timeframe. For example, after a wind facility is announced, it is not atypical for a map of the expected locations of the turbines to be circulated in the community, allowing home buyers and sellers to assess the distance of the planned facility from homes. Because of this assumed difference in when awareness begins for VIEW and DISTANCE, the DISTANCE variable is populated for transactions occurring in the post-announcement-pre-construction period as well as the post-construction period (see Table 14 below), but the VIEW variable is populated only for transactions in the post-construction period – as they were in the Base Model.[76]

Table 14: Frequency Summary for DISTANCE in All Sales Model

	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Post-Construction	67	58	2019	1923	870	4937
Post-Announcement-Pre-Construction	13	7	340	277	130	767
TOTAL	80	65	2359	2200	1000	5704

One beneficial consequence of the differences in reference categories for the VIEW and DISTANCE variables in this model, as opposed to the Base Model, is that this model can accommodate all of the possible VIEW and DISTANCE categories, including NO VIEW transactions and transactions of homes outside of five miles. Because of the inclusion of these VIEW and DISTANCE categories, the tests to investigate Area, Scenic Vista, and Nuisance Stigmas are slightly different in this model than in the Base Model. For Area Stigma, for example, how homes with no view of the turbines fared can now be tested; if they are adversely affected by the presence of the wind facility, then this would imply a pervasive Area Stigma impact. For Scenic Vista Stigma, the VIEW coefficients (MINOR, MODERATE, etc.) can be compared (using a *t*-Test) to the NO VIEW results; if they are significantly different, a Scenic Vista Stigma would be an obvious culprit. Finally, for Nuisance Stigma, the DISTANCE coefficients inside of one mile can be compared (using a *t*-Test) to those outside of five miles; if there is a significant difference between these two categories of homes, then homes are likely affected by their proximity to the wind facility.

5.3.2. Analysis of Results

Results for the variables of interest for this hedonic model are summarized in Table 15, and Base Model results are shown for comparison purposes. (For brevity, the full set of results for the model is not shown in Table 15, but is instead included in Appendix H.) The adjusted R^2 for the model is 0.75, down slightly from 0.77 for the Base Model, and indicating that this model has slightly more difficulty (i.e. less explanatory power) modeling transactions that occurred pre-

[76] It is conceivable that VIEW effects could occur before the turbines are constructed. In some cases, for example, developers will simulate what the project will look like after construction during the post-announcement but pre-construction timeframe. In these situations, home buyers and sellers might adjust home values accordingly based on the expected views of turbines. It is assumed, however, that such adjustments are likely to be reasonably rare, and VIEW effects are therefore estimated using only post-construction sales.

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construction.[77] All study area, spatial adjustment, and home and site characteristics are significant at or above the one percent level and are similar in sign and magnitude to the estimates derived from the post-construction Base Model.

The VIEW coefficients (β_4) are clearly affected by the change in reference category. All of the VIEW parameter estimates are higher than the Base Model estimates for the same categories. Of particular interest is the NO VIEW coefficient, which represents the values of homes without a view of the turbines and that sold in the post-construction period, as compared to the mean value of homes that sold in the pre-construction period, all else being equal. These homes, on average, are estimated to sell for 2% (p value 0.08) more than similar pre-construction homes. If an Area Stigma existed, a negative coefficient for these NO VIEW homes would be expected. Instead, a positive and statistically significant coefficient is found.[78] It is outside the ability of this study to determine whether the increase is directly related to the wind turbines, or whether some other factor is impacting these results, but in either instance, no evidence of a pervasive Area Stigma associated with the presence of the wind facilities is found.

To test for the possibility of Scenic Vista Stigma, the coefficients for MINOR, MODERATE, SUBSTANTIAL, and EXTREME views can be compared to the NO VIEW coefficient using a simple t-Test. Table 16 presents these results. As shown, no significant difference is found for any of the VIEW coefficients when compared to NO VIEW transactions. This reinforces the findings earlier that, within the sample at least, there is no evidence of a Scenic Vista Stigma.

The DISTANCE parameter estimates (β_5) are also found to be affected by the change in reference category, and all are lower than the Base Model estimates for the same categories. This result likely indicates that the inflation-adjusted mean value of homes in the pre-announcement period is slightly higher, on average, than for those homes sold outside of five miles in the post-construction period. This difference could be attributed to the inaccuracy of the inflation index, a pervasive effect from the wind turbines, or to some other cause. Because the coefficients are not systematically statistically significant, however, this result is not pursued further. What is of interest, however, is the negative 8% estimate for homes located between 3000 feet and one mile of the nearest wind turbine (p value 0.03). To correctly interpret this result, and to compare it to the Base Model, one needs to discern if this coefficient is significantly different from the estimate for homes located outside of five miles, using a t-Test.

The results of this t-Test are shown in Table 17. The coefficient differences are found to be somewhat monotonically ordered. Moving from homes within 3000 feet (-0.06, p value 0.22), and between 3000 feet and one mile (-0.08, p value 0.04), to between one and three miles (0.00, p value 0.93) and between three and five miles (0.01, p value 0.32) the DISTANCE coefficients are found to generally increase. Nonetheless, none of these coefficients are statistically significant except one, homes that sold between 3000 feet and one mile. The latter finding suggests the possibility of Nuisance Stigma. It is somewhat unclear why an effect would be found in this model, however, when one was not evident in the Base Model. The most likely

[77] This slight change in performance is likely due to the inaccuracies of home and site characteristics and the inflation adjustment for homes that sold in the early part of the study period. This is discussed in more detail in footnote 50 on page 23.

[78] For more on the significance level used for this report, see footnote 68 on page 30.

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explanation is that the additional homes that are included in this model, specifically those homes that sold post-announcement but pre-construction, are driving the results. A thorough investigation of these "temporal" issues is provided in the next subsection.

In summation, no evidence is found of an Area or Scenic Vista Stigma in this alternative hedonic model, but some limited not-conclusive evidence of a Nuisance Stigma is detected. To further explore the reliability of this latter result, the analysis now turns to the Temporal Aspects Model.

Table 15: Results from All Sales Model

	Base Model				All Sales			
Variables of Interest	**Coef**	**SE**	**p Value**	***n***	**Coef**	**SE**	**p Value**	***n***
Pre-Construction Sales	n/a	n/a	n/a	n/a	Omitted	Omitted	Omitted	2,522
No View	Omitted	Omitted	Omitted	4,207	0.02	0.01	0.08	4,207
Minor View	-0.01	0.01	0.39	561	0.00	0.02	0.77	561
Moderate View	0.02	0.03	0.57	106	0.03	0.03	0.41	106
Substantial View	-0.01	0.07	0.92	35	0.03	0.07	0.53	35
Extreme View	0.02	0.09	0.77	28	0.06	0.08	0.38	28
Inside 3000 Feet	-0.05	0.06	0.31	67	-0.06	0.05	0.18	80
Between 3000 Feet and 1 Mile	-0.05	0.05	0.20	58	-0.08	0.05	0.03	65
Between 1 and 3 Miles	0.00	0.02	0.80	2,019	0.00	0.01	0.80	2,359
Between 3 and 5 Miles	0.02	0.01	0.26	1,923	0.01	0.01	0.59	2,200
Outside 5 Miles	Omitted	Omitted	Omitted	870	0.00	0.02	0.78	1,000
Pre-Announcement Sales	n/a	n/a	n/a	n/a	Omitted	Omitted	Omitted	1,755

"Omitted" = reference category for fixed effects variables. "n" = number of cases in category when category = "1"

Model Information

Model Equation Number	**1**	**6**
Dependent Variable	**LN_SalePrice96**	**LN_SalePrice96**
Number of Cases	**4937**	**7459**
Number of Predictors (k)	**37**	**39**
F Statistic	**442.8**	**579.9**
Adjusted R Squared	**0.77**	**0.75**

Table 16: Results from Equality Test of VIEW Coefficients in the All Sales Model

	No View	**Minor View**	**Moderate View**	**Substantial View**	**Extreme View**
n	4,207	561	106	35	28
Coefficient	0.02	0.00	0.03	0.03	0.06
Coefficient Difference *	Reference	-0.02	0.00	0.01	0.04
Variance	0.0001	0.0003	0.0009	0.0030	0.0050
Covariance	n/a	0.00011	0.00010	0.00009	0.00008
Df	n/a	7419	7419	7419	7419
***t*-Test**	n/a	-1.20	0.17	0.23	0.58
Significance	n/a	0.23	0.87	0.82	0.57

** Differences are rounded to the nearest second decimal place.*
"n" = number of cases in category when category = "1"

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Table 17: Results from Equality Test of DISTANCE Coefficients in the All Sales Model

	Inside 3000 Feet	Between 3000 Feet and 1 Mile	Between 1 and 3 Miles	Between 3 and 5 Miles	Outside 5 Miles
n	80	65	2,359	2,200	1,000
Coefficient	-0.06	-0.08	0.00	0.01	0.00
Coefficient Difference *	-0.05	-0.08	0.00	0.01	Reference
Variance	0.0019	0.0015	0.0002	0.0002	0.0003
Covariance	0.00010	0.00013	0.00013	0.00015	n/a
Df	7419	7419	7419	7419	n/a
t Test	-1.23	-2.06	0.09	1.00	n/a
Significance	0.22	0.04	0.93	0.32	n/a

** Differences are rounded to the nearest second decimal place.*
"n" = number of cases in category when category = "1"

5.4. Temporal Aspects Model

Based on the results of the All Sales Model, a more thorough investigation of how Nuisance and Area Stigma effects might change throughout the wind project development period is warranted. As discussed previously, there is some evidence that property value impacts may be particularly strong after the announcement of a disamenity, but then may fade with time as the community adjusts to the presence of that disamenity (e.g., Wolsink, 1989). The Temporal Aspects Model presented here allows for an investigation of how the different periods of the wind project development process affect estimates for the impact of DISTANCE on sales prices.

5.4.1. Dataset and Model Form

Here the full set of 7,459 residential transactions is used, allowing an exploration of potential property value impacts (focusing on the DISTANCE variable) throughout time, including in the pre-construction period. The following model is then estimated:

$$\ln(\mathrm{P}) = \beta_0 + \beta_1 \mathrm{N} + \sum_{\mathrm{s}} \beta_2 \mathrm{S} + \sum_{\mathrm{k}} \beta_3 \mathrm{X} + \sum_{\mathrm{v}} \beta_4 \mathrm{VIEW} + \sum_{\mathrm{y}} \beta_5 (\mathrm{DISTANCE} \cdot \mathrm{PERIOD}) + \varepsilon \qquad (7)$$

where
DISTANCE is a vector of categorical distance variables (e.g., less than one mile, between one and three miles, etc.),
PERIOD is a vector of categorical development period variables (e.g., after announcement and before construction, etc.),
β_5 is a vector of y parameter estimates for each DISTANCE and PERIOD category as compared to the transactions more than two years before announcement and outside of five miles, and all other components are as defined in equation (1).

The PERIOD variable contains six different options:
1) More than two years before announcement;
2) Less than two years before announcement;
3) After announcement but before construction;
4) Less than two years after construction;
5) Between two and four years after construction; and

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6) More than four years after construction.

In contrast to the Base Model, the two DISTANCE categories inside of one mile are collapsed into a single "less than one mile" group. This approach increases the number of transactions in each crossed subcategory of data, and therefore enhances the stability of the parameter estimates and decreases the size of the standard errors, thus providing an increased opportunity to discover statistically significant effects. Therefore, in this model the DISTANCE variable contains four different options:

1) Less than one mile;
2) Between one and three miles;
3) Between three and five miles; and
4) Outside of five miles.[79]

The number of transactions in each of the DISTANCE and PERIOD categories is presented in Table 18.

The coefficients of interest are β_5, which represent the vector of marginal differences between homes sold at various distances from the wind facility (DISTANCE) during various periods of the development process (PERIOD) as compared to the reference group. The reference group in this model consists of transactions that occurred more than two years before the facility was announced for homes that were situated more than five miles from where the turbines were ultimately constructed. It is assumed that the value of these homes would not be affected by the future presence of the wind facility. The VIEW parameters, although included in the model, are not interacted with PERIOD and therefore are treated as controlling variables.[80]

Although the comparisons of these categorical variables between different DISTANCE and PERIOD categories is be interesting, it is the comparison of coefficients within each PERIOD and DISTANCE category that is the focus of this section. Such comparisons, for example, allow one to compare how the average value of homes inside of one mile that sold two years before announcement compare to the average value of homes inside of one mile that sold in the post-announcement-pre-construction period. For this comparison, a *t*-Test similar to that in the All Sales Model is used.

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[79] For homes that sold in the pre-construction time frame, no turbines yet existed, and therefore DISTANCE is created using a proxy: the Euclidian distance to where the turbines were eventually constructed. This approach introduces some bias when there is more than one facility in the study area. Conceivably, a home that sold in the post-announcement-pre-construction period of one wind facility could also be assigned to the pre-announcement period of another facility in the same area. For this type of sale, it is not entirely clear which PERIOD and DISTANCE is most appropriate, but every effort was made to apply the sale to the wind facility that was most likely to have an impact. In most cases this meant choosing the closest facility, but in some cases, when development periods were separated by many years, simply the earliest facility was chosen. In general, any bias created by these judgments is expected to be minimal because, in the large majority of cases, the development process in each study area was more-or-less continuous and focused in a specific area rather then being spread widely apart.

[80] As discussed earlier, the VIEW variable was considered most relevant for the post-construction period, so delineations based on development periods that extended into the pre-construction phase were unnecessary. It is conceivable, however, that VIEW effects vary in periods following construction, such as in the first two years or after that. Although this is an interesting question, the numbers of cases for the SUBSTANTIAL and EXTREME ratings – even if combined – when divided into the temporal periods were too small to be fruitful for analysis.

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Table 18: Frequency Crosstab of DISTANCE and PERIOD

	More Than 2 Years Before Announcement	Less Than 2 Years Before Announcement	After Announcement Before Construction	Less Than 2 Years After Construction	Between 2 and 4 Years After Construction	More Than 4 Years After Construction	Total
Less Than 1 Mile	38	40	20	39	45	43	225
Between 1 and 3 Miles	283	592	340	806	502	709	3,232
Between 3 and 5 Miles	157	380	277	572	594	757	2,737
Outside of 5 Miles	132	133	130	218	227	425	1,265
TOTAL	610	1,145	767	1,635	1,368	1,934	7,459

5.4.2. Analysis of Results

Results for the variables of interest for this hedonic model are presented in Table 19; as with previous models, the full set of results is contained in Appendix H. Similar to the All Sales Model discussed in the previous section, the adjusted R^2 for the model is 0.75, down slightly from 0.77 for the Base Model, and indicating that this model has slightly more difficulty (i.e., less explanatory power) modeling transactions that occurred before wind facility construction. All study area, spatial adjustment, and home and site characteristics are significant at or above the one percent level, are of the appropriate sign, and are similar in magnitude to the estimates derived from the post-construction Base Model.

All of the DISTANCE / PERIOD interaction coefficients for distances outside of one mile are relatively small ($-0.04 < \beta_5 < 0.02$) and none are statistically significant. This implies that there are no statistically significant differences in property values between the reference category homes – homes sold more than two years before announcement that were situated outside of five miles from where turbines were eventually erected – and any of the categories of homes that sold outside of one mile at any other period in the wind project development process. These comparisons demonstrate, arguably more directly than any other model presented in this report that Area Stigma effects likely do not exist in the sample.

The possible presence of a Nuisance Stigma is somewhat harder to discern. For homes that sold inside of one mile of the nearest wind turbine, in three of the six periods there are statistically significant negative differences between average property values when compared to the reference category. Transactions completed more than two years before facility announcement are estimated to be valued at 13% less (p value 0.02) than the reference category, transactions less than two years before announcement are 10% lower (p value 0.06), and transactions after announcement but before construction are 14% lower (p value 0.04). For other periods, however, these marginal differences are considerably smaller and are not statistically different from the reference category. Sales prices in the first two years after construction are, on average, 9% less (p value 0.15), those occurring between three and four years following construction are, on average, 1% less (p value 0.86), and those occurring more than four years after construction are, on average, 7% less (p value 0.37).

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Table 19: Results from Temporal Aspects Model

Variables of Interest		Temporal Aspects			
		Coef	SE	p Value	*n*
Inside 1 Mile	More Than 2 Years Before Announcement	-0.13	0.06	0.02	38
	Less Than 2 Years Before Announcement	-0.10	0.05	0.06	40
	After Announcement Before Construction	-0.14	0.06	0.04	21
	2 Years After Construction	-0.09	0.07	0.11	39
	Between 2 and 4 Years After Construction	-0.01	0.06	0.85	44
	More Than 4 Years After Construction	-0.07	0.08	0.22	42
Between 1-3 Miles	More Than 2 Years Before Announcement	-0.04	0.03	0.18	283
	Less Than 2 Years Before Announcement	0.00	0.03	0.91	592
	After Announcement Before Construction	-0.02	0.03	0.54	342
	2 Years After Construction	0.00	0.03	0.90	807
	Between 2 and 4 Years After Construction	0.01	0.03	0.78	503
	More Than 4 Years After Construction	0.00	0.03	0.93	710
Between 3-5 Miles	More Than 2 Years Before Announcement	0.00	0.04	0.92	157
	Less Than 2 Years Before Announcement	0.00	0.03	0.97	380
	After Announcement Before Construction	0.00	0.03	0.93	299
	2 Years After Construction	0.02	0.03	0.55	574
	Between 2 and 4 Years After Construction	0.01	0.03	0.65	594
	More Than 4 Years After Construction	0.01	0.03	0.67	758
Outside 5 Miles	More Than 2 Years Before Announcement	Omitted	Omitted	Omitted	132
	Less Than 2 Years Before Announcement	-0.03	0.04	0.33	133
	After Announcement Before Construction	-0.03	0.03	0.39	105
	2 Years After Construction	-0.03	0.03	0.44	215
	Between 2 and 4 Years After Construction	0.03	0.03	0.44	227
	More Than 4 Years After Construction	0.01	0.03	0.73	424

"Omitted" = reference category for fixed effects variables.
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	7
Dependent Variable	LN_SalePrice96
Number of Cases	7459
Number of Predictors (k)	56
F Statistic	404.5
Adjusted R Squared	0.75

What these results suggest (as shown in Figure 8) is that homes inside of one mile in the sample, on average, were depressed in value (in relation to the reference category) before and after the announcement of the wind facility and up to the point that construction began, but that those values rebounded somewhat after construction commenced.[81] This conclusion also likely explains why a significant and negative effect for homes that sold between 3000 feet and one mile is found in the All Sales Model presented in Section 5.3: homes within this distance range that sold prior to facility construction were depressed in value and most likely drove the results for homes that sold after announcement. Regardless, these results are not suggestive of a pervasive Nuisance Stigma.

[81] As discussed in footnotes 47 (on page 19) and 74 (on page 38), the "announcement date" often refers to the first time the proposed facility appeared in the press. "Awareness" of the project in the community may precede this date, however, and therefore transactions occurring in the period "less than two years before announcement" could conceivably have been influenced by the prospective wind project, but it is considerably less likely that those in the period more than two years before announcement would have been influenced.

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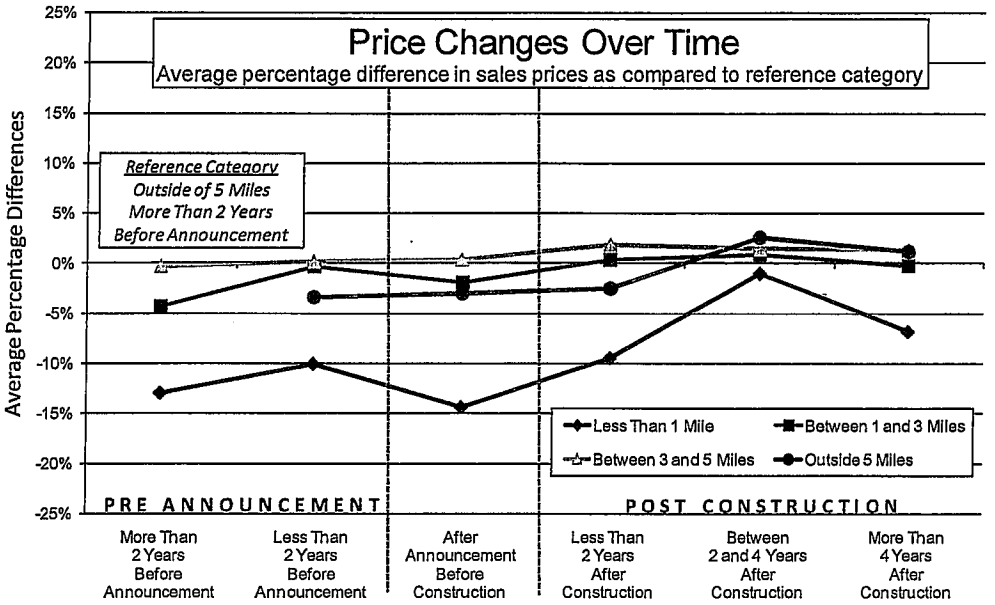
Figure 8: Results from the Temporal Aspects Model



The reference category consists of transactions of homes situated more than five miles from where the nearest turbine would eventually be located and that occurred more than two years before announcement of the facility

To explore Nuisance Stigma further, the analysis again turns to the *t*-Test and compares the coefficients for transactions that occurred more than two years before wind facility announcement (during which time the future wind facility is not expected to have any impact on sales prices) to the estimates for the DISTANCE coefficients in the periods that follow. These results are shown in Table 20. Focusing on those transactions inside of one mile, it is found that all coefficients are greater in magnitude than the reference category except during the post-announcement-pre-construction period (which is 1% less and is not statistically significant; *p* value 0.90), indicating, on average, that home values are increasing or staying stable from the pre-announcement reference period onward. These increases, however, are not statistically significant except in the period of two to four years after construction (0.12, *p* value 0.08). With respect to Nuisance Stigma, the more important result is that, relative to homes that sold well before the wind facility was announced, no statistically significant adverse effect is found in any period within a one mile radius of the wind facility. Therefore, the -5% (albeit not statistically significant) average difference that is found in the Base Model, and the -8% (statistically significant) result that is found in the All Sales Model (for homes between 3000 feet and one mile) appear to both be a reflection of depressed home prices that preceded the construction of the relevant wind facilities. If construction of the wind facilities were downwardly influencing the sales prices of these homes, as might be deduced from the Base or All Sales Models alone, a diminution in the inflation adjusted price would be seen as compared to pre-announcement levels. Instead, an increase is seen. As such, no persuasive evidence of a Nuisance Stigma is evident among this sample of transactions.[82]

[82] It should be noted that the numbers of study areas represented for homes situated inside of one mile but in the periods "more than two years before announcement" and "more than four years after construction" are fewer ($n = 5$) than in the other temporal categories ($n = 8$). Further, the "more than two years before announcement – inside of one mile" category is dominated by transactions from one study area (OKCC). For these reasons, there is less

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Turning to the coefficient differences for distances greater than one mile in Table 20, again, no statistical evidence of significant adverse impacts on home values is uncovered. Where statistically significant differences are identified, the coefficients are greater than the reference category. These findings corroborate the earlier Area Stigma results, and re-affirm the lack of evidence for such an effect among the sample of residential transactions included in this analysis.

Table 20: Results from Equality Test of Temporal Aspects Model Coefficients

	More Than 2 Years Before Announcement	Less Than 2 Years Before Announcement	After Announcement Before Construction	Less Than 2 Years After Construction	Between 2 and 4 Years After Construction	More Than 4 Years After Construction
Less Than 1 Mile	Reference	0.03 (0.45)	-0.01 (-0.13)	0.04 (0.56)	0.12 (1.74)*	0.06 (0.88)
Between 1 and 3 Miles	Reference	0.04 (1.92)*	0.02 (0.86)	0.05 (2.47)**	0.05 (2.27)**	0.04 (1.82)*
Between 3 and 5 Miles	Reference	0.01 (0.37)	0.01 (0.34)	0.02 (0.77)	0.02 (0.78)	0.02 (0.79)
Outside of 5 Miles †	Reference	-0.04 (-0.86)	-0.03 (-0.91)	-0.03 (-0.77)	0.03 (0.81)	0.01 (0.36)

*Numbers in parenthesis are t-Test statistics. Significance = *** 1% level, ** 5% level, * 10% level, <blank> below the 10% level.*

† For homes outside of 5 miles, the coefficient differences are equal to the coefficients in the Temporal Aspects Model, and therefore the t-values were produced via the OLS.

5.5. Orientation Model

All of the hedonic models presented to this point use a VIEW variable that effectively assumes that the impact of a view of wind turbines on property values will not vary based on the orientation of the home to that view; the impact will be the same whether the view is seen from the side of the home or from the back or front. Other literature, however, has found that the impact of wind projects on property values may be orientation-dependent (Sims et al., 2008). To investigate this possibility further a parameter for orientation is included in the model.

5.5.1. Dataset and Model Form

The same dataset is used as in the Base Model, focusing on post-construction transactions (n = 4,937). To investigate whether the orientation of a home to the turbines (ORIENTATION) has a marginal impact on residential property values, over and above that of the VIEW impacts alone, the following hedonic model is estimated:[83]

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confidence in these two estimates (-13% and -7% respectively) than for the estimates for other temporal periods inside of one mile. Based on additional sensitivity analysis not included here, it is believed that if they are biased, both of these estimates are likely biased downward. Further, as discussed in footnote 47 on page 19, there is a potential for bias in the "announcement" date in that awareness of a project may precede the date that a project enters the public record (i.e., the "announcement" date used for this analysis). Taken together, these two issues might imply that the curve shown in Figure 8 for "less than one mile" transactions, instead of having a flat and then increasing shape, may have a more of an inverse parabolic (e.g., "U") shape. This would imply that a relative minimum in sales prices is reached in the period after awareness began of the facility but before construction commenced, and then, following construction, prices recovered to levels similar to those prior to announcement (and awareness). These results would be consistent with previous studies (e.g., Wolsink, 1989; Devine-Wright, 2004) but cannot be confirmed without the presence of more data. Further research on this issue is warranted. In either case, such results would not change the conclusion here of an absence of evidence of a pervasive Nuisance Stigma in the post-construction period.

[83] The various possible orientations of the home to the view of turbines will be, individually and collectively, referred to as "ORIENTATION" in this report.

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$$\ln(P) = \beta_0 + \beta_1 N + \sum_s \beta_2 S + \sum_k \beta_3 X + \sum_v \beta_4 VIEW + \sum_d \beta_5 DISTANCE + \sum_o \beta_6 ORIENTATION + \varepsilon \quad (8)$$

where
ORIENTATION is a vector of *o* ORIENTATION variables (e.g., SIDE, FRONT, and BACK),
β_6 is a vector of *o* parameter estimates for ORIENTATION variables, and
all other components are as defined in equation (1).[84]

The ORIENTATION categories include FRONT, BACK, and SIDE, and are defined as follows:

- SIDE: The orientation of the home to the view of the turbines is from the side.
- FRONT: The orientation of the home to the view of the turbines is from the front.
- BACK: The orientation of the home to the view of the turbines is from the back.

The orientation of the home to the view of the wind facilities was determined in the course of the field visits to each home. If more than one orientation to the turbines best described the home (e.g., back and side, or front, back, and side) they were coded as such (e.g., turbines visible from back and side: SIDE = 1; BACK = 1; FRONT = 0).[85]

Not surprisingly, ORIENTATION is related to VIEW. Table 21 and Table 22 provide frequency and percentage crosstabs of ORIENTATION and VIEW. As shown, those homes with more dramatic views of the turbines generally have more ORIENTATION ratings applied to them. For instance, 25 out of 28 EXTREME VIEW homes have all three ORIENTATION ratings (i.e., FRONT, BACK, and SIDE). Virtually all of the MINOR VIEW homes, on the other hand, have only one ORIENTATION. Further, MINOR VIEW homes have roughly evenly spread orientations to the turbines across the various possible categories of FRONT, BACK, and SIDE. Conversely, a majority of the MODERATE and SUBSTANTIAL VIEW ratings coincide with an ORIENTATION from the back of the house.[86]

[84] Ideally, one would enter ORIENTATION in the model through an interaction with VIEW. There are two ways that could be accomplished: either with the construction of multiple fixed effects ("dummy") variables, which capture each sub-category of VIEW and ORIENTATION, or through a semi-continuous interaction variable, which would be created by multiplying the ordered categorical variable VIEW by an ordered categorical variable ORIENTATION. Both interaction scenarios are problematic, the former because it requires increasingly small subsets of data, which create unstable coefficient estimates, and the latter because there are no *a priori* expectations for the ordering of an ordered categorical ORIENTATION variable and therefore none could be created and used for the interaction. As a result, no interaction between the two variables is reported here.

[85] An "Angle" orientation was also possible, which was defined as being between Front and Side or Back and Side. An Angle orientation was also possible in combination with Back or Front (e.g., Back-Angle or Front-Angle). In this latter case, the orientation was coded as one of the two prominent orientations (e.g., Back or Front). An Angle orientation, not in combination with Front or Back, was coded as Side.

[86] The prevalence of BACK orientations for MODERATE and SUBSTANTIAL VIEW homes may be because BACK views might more-frequently be kept without obstruction, relative to SIDE views.

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Table 21: Frequency Crosstab of VIEW and ORIENTATION

		VIEW				
		Minor	Moderate	Substantial	Extreme	Total
ORIENTATION	Front	217	33	17	27	294
	Back	164	67	24	25	280
	Side	194	17	15	27	253
	Total	561	106	35	28	730

Note: Total of ORIENTATION does not sum to 730 because multiple orientations are possible for each VIEW.

Table 22: Percentage Crosstab of VIEW and ORIENTATION

		VIEW				
		Minor	Moderate	Substantial	Extreme	Total
ORIENTATION	Front	39%	31%	49%	96%	40%
	Back	29%	63%	69%	89%	38%
	Side	35%	16%	43%	96%	35%

Note: Percentages are calculated as a portion of the total for each VIEW ratings (e.g., 24 of the 35 SUBSTANTIAL rated homes have a BACK ORIENTATION = 69%). Columns do not sum to 100% because multiple orientations are possible for each VIEW.

The parameter estimates of interest in this hedonic model are those for ORIENTATION (β_6) and VIEW (β_4). β_6 represent the marginal impact on home value, over and above that of VIEW alone, of having a particular orientation to the turbines. In the Base Model the VIEW coefficients effectively absorb the effects of ORIENTATION, but in this model they are estimated separately. Because a home's surrounding environment is typically viewed from the front or back of the house, one would expect that, to the extent that wind facility VIEW impacts property values, that impact would be especially severe for homes that have FRONT or BACK orientations to those turbines. If this were the case, the coefficients for these categories would be negative, while the coefficient for SIDE would be to be close to zero indicating little to no incremental impact from a SIDE ORIENTATION.

5.5.2. Analysis of Results

Results for the variables of interest for this hedonic model are shown in Table 23; as with previous models, the full set of results is contained in Appendix H. The model performs well with an adjusted R^2 of 0.77. All study area, spatial adjustment, and home and site characteristics are significant at or above the one percent level, are of the appropriate sign, and are similar in magnitude to the estimates derived from the post-construction Base Model. The coefficients for DISTANCE and VIEW are stable, in sign and magnitude, when compared to the Base Model results, and none of the marginal effects are statistically significant.

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The coefficients for the variables of interest (β_6) do not meet the *a priori* expectations. The estimated effect for SIDE ORIENTATION, instead of being close to zero, is -3% (*p* value 0.36), while BACK and FRONT, instead of being negative and larger, are estimated at 3% (*p* value 0.37) and -1% (*p* value 0.72), respectively. None of these variables are found to be even marginally statistically significant, however, and based on these results, it is concluded that there is no evidence that a home's orientation to a wind facility affects property values in a measurable way. Further, as with previous models, no statistical evidence of a Scenic Vista Stigma is found among this sample of sales transactions.

Table 23: Results from Orientation Model

	Base Model				Orientation Model			
Variables of Interest	**Coef**	**SE**	**p Value**	***n***	**Coef**	**SE**	**p Value**	***n***
No View	Omitted	Omitted	Omitted	4207	Omitted	Omitted	Omitted	4207
Minor View	-0.01	0.01	0.39	561	-0.01	0.06	0.88	561
Moderate View	0.02	0.03	0.57	106	0.00	0.06	0.96	106
Substantial View	-0.01	0.07	0.92	35	-0.01	0.09	0.85	35
Extreme View	0.02	0.09	0.77	28	0.02	0.17	0.84	28
Inside 3000 Feet	-0.05	0.06	0.31	67	-0.04	0.07	0.46	67
Between 3000 Feet and 1 Mile	-0.05	0.05	0.20	58	-0.05	0.05	0.26	58
Between 1 and 3 Miles	0.00	0.02	0.80	2019	0.00	0.02	0.83	2019
Between 3 and 5 Miles	0.02	0.01	0.26	1923	0.02	0.01	0.26	1923
Outside 5 Miles	Omitted	Omitted	Omitted	870	Omitted	Omitted	Omitted	870
Front Orientation					-0.01	0.06	0.72	294
Back Orientation					0.03	0.06	0.37	280
Side Orientation					-0.03	0.06	0.36	253

"Omitted" = reference category for fixed effects variables. "n" = number of cases in category when category = "1"

Model Information

Model Equation Number	**1**	**8**
Dependent Variable	**LN_SalePrice96**	**LN_SalePrice96**
Number of Cases	**4937**	**4937**
Number of Predictors (k)	**37**	**40**
F Statistic	**442.8**	**410.0**
Adjusted R Squared	**0.77**	**0.77**

5.6. Overlap Model

The Orientation Model, presented above, investigated, to some degree, how the potential effects of wind turbines might be impacted by how a home is oriented to the surrounding environment. In so doing, this model began to peel back the relationship between VIEW and VISTA, but stopped short of looking at the relationship directly. It would be quite useful, though, to understand the explicit relationship between the VISTA and VIEW variables. In particular, one might expect that views of wind turbines would have a particularly significant impact on residential property values when those views strongly overlap ("OVERLAP") the prominent scenic vista from a home. To investigate this possibility directly, and, in general, the relationship between VIEW and VISTA, a parameter for OVERLAP is included in the model.

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5.6.1. Dataset and Model Form

Data on the degree to which the view of wind turbines overlaps with the prominent scenic vista from the home (OVERLAP) were collected in the course of the field visits to each home.[87] The categories for OVERLAP included NONE, BARELY, SOMEWHAT, and STRONGLY, and are described in Table 24: [88]

Table 24: Definition of OVERLAP Categories

OVERLAP - NONE	The scenic vista does not contain any view of the turbines.
OVERLAP - BARELY	A small portion (~ 0 - 20%) of the scenic vista is overlapped by the view of turbines, and might contain a view of a few turbines, only a few of which can be seen entirely.
OVERLAP - SOMEWHAT	A moderate portion (~20-50%) of the scenic vista contains turbines, and likely contains a view of more than one turbine, some of which are likely to be seen entirely.
OVERLAP - STRONGLY	A large portion (~50-100%) of the scenic vista contains a view of turbines, many of which likely can be seen entirely.

A crosstab describing the OVERLAP designations and the VIEW categories is shown in Table 25. As would be expected, the more dramatic views of wind turbines, where the turbines occupy more of the panorama, are coincident with the OVERLAP categories of SOMEWHAT or STRONGLY. Nonetheless, STRONGLY are common for all VIEW categories. Similarly, SOMEWHAT is well distributed across the MINOR and MODERATE rated views, while BARELY is concentrated in the MINOR rated views.

The same dataset is used as in the Base Model, focusing on post-construction transactions (n = 4,937). To investigate whether the overlap of VIEW and VISTA has a marginal impact on residential property values, over and above that of the VIEW and VISTA impacts alone, the following hedonic model is estimated:[89]

$$\ln(\mathrm{P}) = \beta_0 + \beta_1 \mathrm{N} + \sum_{\mathrm{s}} \beta_2 \mathrm{S} + \sum_{\mathrm{k}} \beta_3 \mathrm{X} + \sum_{\mathrm{v}} \beta_4 \mathrm{VIEW} + \sum_{\mathrm{d}} \beta_5 \mathrm{DISTANCE} + \sum_{\mathrm{t}} \beta_6 \mathrm{VISTA} + \sum_{\mathrm{p}} \beta_7 \mathrm{OVERLAP} + \varepsilon \quad (9)$$

where
VIEW is a vector of v categorical view variables (e.g., MINOR, MODERATE, etc.),
VISTA is a vector of t categorical scenic vista variables (e.g., POOR, BELOW-AVERAGE, etc.),
OVERLAP is a vector of p categorical overlap variables (e.g., BARELY, SOMEWHAT, etc.),

[87] Scenic vista was rated while taking into account the entire panorama surrounding a home. But, for each home, there usually was a prominent direction that offered a preferred scenic vista. Often, but not always, the home was orientated to enjoy that prominent scenic vista. Overlap is defined as the degree to which the view of the wind facility overlaps with this prominent scenic vista.

[88] "...can be seen entirely" refers to being able to see a turbine from the top of the sweep of its blade tips to below the nacelle of the turbine where the sweep of the tips intersects the tower.

[89] Although VISTA appears in all models, and is usually included in the vector of home and site characteristics represented by X, it is shown separately here so that it can be discussed directly in the text that follows.

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β_4 is a vector of v parameter estimates for VIEW fixed effects variables as compared to transactions of homes without a view of the turbines,
β_6 is a vector of t parameter estimates for VISTA fixed effect variables as compared to transactions of homes with an AVERAGE scenic vista,
β_7 is a vector of o parameter estimates for OVERLAP fixed effect variables as compared to transactions of homes where the view of the turbines had no overlap with the scenic vista, and all other components are as defined in equation (1).

The variables of interest in this model are VIEW, VISTA and OVERLAP, and the coefficients β_4, β_6, and β_7 are therefore the primary focus. Theory would predict that the VISTA coefficients in this model would be roughly similar to those derived in the Base Model, but that the VIEW coefficients may be somewhat more positive as the OVERLAP variables explain a portion of any negative impact that wind projects have on residential sales prices. In that instance, the OVERLAP coefficients would be negative, indicating a decrease in sales price when compared to those homes that experience no overlap between the view of wind turbines and the primary scenic vista.

Table 25: Frequency Crosstab of OVERLAP and VIEW

		VIEW					
		None	Minor	Moderate	Substantial	Extreme	Total
OVERLAP	None	4,207	317	3	0	0	4,527
	Barely	0	139	10	1	0	150
	Somewhat	0	81	42	7	2	132
	Strongly	0	24	51	27	26	128
	Total	4,207	561	106	35	28	4,937

5.6.2. Analysis of Results

Results for the variables of interest for this hedonic model are shown in Table 26; as with previous models, the full set of results is contained in Appendix H. The model performs well with an adjusted R^2 of 0.77. All study area, spatial adjustment, and home and site characteristics are significant at or above the one percent level, are of the appropriate sign, and are similar in magnitude to the estimates derived from the post-construction Base Model.

As expected from theory, the VISTA parameters are stable across models with no change in coefficient sign, magnitude, or significance. Counter to expectations, however, the VIEW coefficients, on average, decrease in value. MINOR VIEW is now estimated to adversely affect a home's sale price by 3% (p value 0.10) and is weakly significant, but none of the other VIEW categories are found to be statistically significant. Oddly, the OVERLAP rating of BARELY is found to significantly increase home values by 5% (p value 0.08), while none of the other OVERLAP ratings are found to have a statistically significant impact.

Taken at face value, these results are counterintuitive. For instance, absent any overlap of view with the scenic vista (NONE), a home with a MINOR view sells for 3% less than a home with no view of the turbines. If, alternatively, a home with a MINOR view BARELY overlaps the prominent scenic vista, it not only enjoys a 2% increase in value over a home with NO VIEW of the turbines but a 5% increase in value over homes with views of the turbines that do not overlap

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with the scenic vista. In other words, the sales price increases when views of turbines overlap the prominent scenic vista, at least in the BARELY category. A more likely explanation for these results are that the relatively high correlation (0.68) between the VIEW and OVERLAP parameters is spuriously driving one set of parameters up and the other down. More importantly, when the parameters are combined, they offer a similar result as was found in the Base Model. Therefore, it seems that the degree to which the view of turbines overlaps the scenic vista has a negligible effect on sales prices among the sample of sales transactions analyzed here.[90]

Despite these somewhat peculiar results, other than MINOR, none of the VIEW categories are found to have statistically significant impacts, even after accounting for the degree to which those views overlap the scenic vista. Similarly, none of the OVERLAP variables are simultaneously negative and statistically significant. This implies, once again, that a Scenic Vista Stigma is unlikely to be present in the sample. Additionally, none of the DISTANCE coefficients are statistically significant, and those coefficients remain largely unchanged from the Base Model, reaffirming previous results in which no significant evidence of either an Area or a Nuisance Stigma was found.

[90] An alternative approach to this model was also considered, one that includes an interaction term between VIEW and VISTA. For this model it is assumed that homes with higher rated scenic vistas might have higher rated views of turbines, and that these views of turbines would decrease the values of the scenic vista. To construct the interaction, VISTA, which can be between one and five (e.g., POOR=1,...PREMIUM=5), was multiplied by VIEW, which can be between zero and four (e.g. NO VIEW=0, MINOR=1,...EXTREME=4). The resulting interaction (VIEW*VISTA) therefore was between zero and sixteen (there were no PREMIUM VISTA homes with an EXTREME VIEW), with zero representing homes without a view of the turbines, one representing homes with a POOR VISTA and a MINOR VIEW, and sixteen representing homes with either a PREMIUM VISTA and a SUBSTANTIAL VIEW or an ABOVE AVERAGE VISTA and an EXTREME VIEW. The interaction term, when included in the model, was relatively small (-0.013) and weakly significant (p value 0.10 – not White's corrected). The VISTA estimates were unchanged and the VIEW parameters were considerably larger and positive. For instance, EXTREME was 2% in the Base Model and 16% in this "interaction" model. Similarly, SUBSTANTIAL was -1% in the Base Model and 13% in this model. Therefore, although the interaction term is negative and weakly significant, the resulting VIEW estimates, to which it would need to be added, fully offset this negative effect. These results support the idea that the degree to which a VIEW overlaps VISTA has a likely negligible effect on sales prices, while also confirming that there is a high correlation between the interaction term and VIEW variables.

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Table 26: Results from Overlap Model

Variables of Interest	Base Model				Overlap Model			
	Coef	SE	p Value	*n*	Coef	SE	p Value	*n*
No View	Omitted	Omitted	Omitted	4,207	Omitted	Omitted	Omitted	4,207
Minor View	-0.01	0.01	0.39	561	-0.03	0.02	0.10	561
Moderate View	0.02	0.03	0.57	106	-0.02	0.04	0.65	106
Substantial View	-0.01	0.07	0.92	35	-0.05	0.09	0.43	35
Extreme View	0.02	0.09	0.77	28	-0.03	0.10	0.73	28
Inside 3000 Feet	-0.05	0.06	0.31	67	-0.05	0.06	0.32	67
Between 3000 Feet and 1 Mile	-0.05	0.05	0.20	58	-0.05	0.05	0.27	58
Between 1 and 3 Miles	0.00	0.02	0.80	2,019	0.00	0.02	0.82	2,019
Between 3 and 5 Miles	0.02	0.01	0.26	1,923	0.02	0.01	0.26	1,923
Outside 5 Miles	Omitted	Omitted	Omitted	870	Omitted	Omitted	Omitted	870
Poor Vista	-0.21	0.02	0.00	310	-0.21	0.02	0.00	310
Below Average Vista	-0.08	0.01	0.00	2,857	-0.08	0.01	0.00	2,857
Average Vista	Omitted	Omitted	Omitted	1,247	Omitted	Omitted	Omitted	1,247
Above Average Vista	0.10	0.02	0.00	448	0.10	0.02	0.00	448
Premium Vista	0.13	0.04	0.00	75	0.13	0.04	0.00	75
View Does Not Overlap Vista					Omitted	Omitted	Omitted	320
View Barely Overlaps Vista					0.05	0.03	0.08	150
View Somewhat Overlaps Vista					0.01	0.03	0.66	132
View Strongly Overlaps Vista					0.05	0.05	0.23	128

"Omitted" = reference category for fixed effects variables. "n" = number of cases in category when category = "1"

Model Information

Model Equation Number	1	9
Dependent Variable	LN_SalePrice96	LN_SalePrice96
Number of Cases	4937	4937
Number of Predictors (k)	37	40
F Statistic	442.8	409.7
Adjusted R Squared	0.77	0.77

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6. Repeat Sales Analysis

In general, the Base and Alternative Hedonic Models presented in previous sections come to the same basic conclusion: wind power facilities in this sample have no demonstrable, widespread, sizable, and statistically significant affect on residential property values. These hedonic models contain 29 or more controlling variables (e.g., house and site characteristics) to account for differences in home values across the sample. Although these models perform well and explain nearly 80% of the variation in sales prices among homes in the sample, it is always possible that variables not included in (i.e., "omitted from") the hedonic models could be correlated with the variables of interest, therefore biasing the results.

A common method used to control for omitted variable bias in the home assessment literature is to estimate a repeat sales model (Palmquist, 1982). This technique focuses on just those homes that have sold on more than one occasion, preferably once before and once after the introduction of a possible disamenity, and investigates whether the price appreciation between these transactions is affected by the presence of that disamenity. In this section a repeat sales analysis is applied to the dataset, investigating in a different way the presence of the three possible property value stigmas associated with wind facilities, and therefore providing an important cross-check to the hedonic model results. The section begins with a brief discussion of the general form of the Repeat Sales Model and a summary of the literature that has employed this approach to investigate environmental disamenities. The dataset and model used in the analysis is then described, followed by a summary of the results from that analysis.

6.1. Repeat Sales Models and Environmental Disamenities Literature

Repeat sales models use the annual sales-price appreciation rates of homes as the dependent variable. Because house, home site, and neighborhood characteristics are relatively stable over time for any individual home, many of those characteristics need not be included in the repeat sales model, thereby increasing the degrees of freedom and allowing sample size requirements to be significantly lower and coefficient estimates to be more efficient (Crone and Voith, 1992). A repeat sales analysis is not necessarily preferred over a traditional hedonic model, but is rather an alternative analysis approach that can be used to test the robustness of the earlier results (for further discussion see Jackson, 2003). The repeat sales model takes the basic form:

Annual Appreciation Rate (AAR) = f(TYPE OF HOUSE, OTHER FACTORS)

where
TYPE OF HOUSE provides an indication of the segment of the market in which the house is situated (e.g., high end vs. low end), and
OTHER FACTORS include, but are not limited to, changes to the environment (e.g., proximity to a disamenity).

The dependent variable is the adjusted annual appreciation rate and is defined as follows:

$$AAR = \exp\left[\frac{\ln(P_1 / P_2)}{t_1 - t_2}\right] - 1 \qquad (10)$$

where

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P_1 is the adjusted sales price at the first sale (in 1996 dollars),
P_2 is the adjusted sales price at the second sale (in 1996 dollars),
t_1 is the date of the first sale,
t_2 is the date of the second sale, and
$(t_1 - t_2)$ is determined by calculating the number of days that separate the sale dates and dividing by 365.

As with the hedonic regression model, the usefulness of the repeat sales model is well established in the literature when investigating possible disamenities. For example, a repeat sales analysis was used to estimate spatial and temporal sales price effects from incinerators by Kiel and McClain (1995), who found that appreciation rates, on average, are not sensitive to distance from the facility during the construction phase but are during the operation phase. Similarly, McCluskey and Rausser (2003) used a repeat sales model to investigate effects surrounding a hazardous waste site. They found that appreciation rates are not sensitive to the home's distance from the disamenity before that disamenity is identified by the EPA as hazardous, but that home values are impacted by distance after the EPA's identification is made.

6.2. Dataset

The 7,459 residential sales transactions in the dataset contain a total of 1,253 transactions that involve homes that sold on more than one occasion (i.e., a "pair" of sales of the same home). For the purposes of this analysis, however, the key sample consists of homes that sold once before the announcement of the wind facility, and that subsequently sold again after the construction of that facility. Therefore any homes that sold twice in either the pre-announcement or post-construction periods were not used in the repeat sales sample.[91] These were excluded because either they occurred before the effect would be present (for pre-announcement pairs) or after (for post-announcement pairs). This left a total of 368 pairs for the analysis, which was subsequently reduced to 354 usable pairs.[92]

The mean AAR for the sample is 1.0% per year, with a low of -10.5% and a high of 13.4%. Table 27 summarizes some of the characteristics of the homes used in the repeat sales model. The average house in the sample has 1,580 square feet of above-ground finished living area, sits on a parcel of 0.67 acres, and originally sold for $70,483 (real 1996 dollars). When it sold a second time, the average home in the sample was located 2.96 miles from the nearest wind turbine (14 homes were within one mile, 199 between one and three miles, 116 between three and five miles, and 25 outside of five miles). Of the 354 homes, 14% ($n = 49$) had some view of the facility (35 were rated MINOR, five MODERATE, and nine either SUBSTANTIAL or EXTREME). Because of the restriction to those homes that experienced repeat sales, the sample is relatively small for those homes in close proximity to and with dramatic views of wind facilities.

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[91] 752 pairs occurred after construction began, whereas 133 pairs occurred before announcement.

[92] Of the 368 pairs, 14 were found to have an AAR that was either significantly above or below the mean for the sample (mean +/- 2 standard deviations). These pairs were considered highly likely to be associated with homes that were either renovated or left to deteriorate between sales, and therefore were removed from the repeat sales model dataset. Only two of these 14 homes had views of the wind turbines, both of which were MINOR. All 14 of the homes were situated either between one and three miles from the nearest turbine ($n = 8$) or between three and five miles away ($n = 6$).

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Table 27: List of Variables Included in the Repeat Sales Model

Variable Name	Description	Type	Sign	Freq.	Mean	Std. Dev.	Min.	Max.
SalePrice96_Pre	The Sale Price (adjusted for inflation into 1996 dollars) of the home as of the first time it had sold	C	+	354	$ 70,483	$ 37,798	$ 13,411	$ 291,499
SalePrice96_Pre_Sqr	SalePrice96_Pre Squared (shown in millions)	C	–	354	$ 6,393	$ 8,258	$ 180	$ 84,972
Acres	Number of Acres that sold with the residence	C	+	354	0.67	1.34	0.07	10.96
Sqft_1000	Number of square feet of finished above ground living area (in 1000s)	C	+	354	1.58	0.56	0.59	4.06
No View	If the home had no view of the turbines when it sold for the second time (Yes = 1, No = 0)	Omitted	n/a	305	0.86	0.35	0	1
Minor View	If the home had a Minor View of the turbines when it sold for the second time (Yes = 1, No = 0)	OC	–	35	0.10	0.30	0	1
Moderate View	If the home had a Moderate View of the turbines when it sold for the second time (Yes = 1, No = 0)	OC	–	5	0.01	0.12	0	1
Substantial/Extreme View	If the home had a Substantial or Extreme View of the turbines when it sold for the second time (Yes = 1, No = 0)	OC	–	9	0.03	0.12	0	1
Less than 1 Mile	If the home was within 1 mile (5280 feet) of the turbines when it sold for the second time (Yes = 1, No = 0)	OC	–	14	0.02	0.13	0	1
Between 1 and 3 Miles	If the home was between 1 and 3 miles of the turbines when it sold for the second time (Yes = 1, No = 0)	OC	–	199	0.56	0.50	0	1
Between 3 and 5 Miles	If the home was between 3 and 5 miles of the turbines when it sold for the second time (Yes = 1, No = 0)	OC	–	116	0.33	0.47	0	1
Outside 5 Miles	If the home was outside 5 miles of the turbines when it sold for the second time (Yes = 1, No = 0)	Omitted	n/a	25	0.07	0.26	0	1

"C" Continuous, "OC" Ordered Categorical (1 = yes, 0 = no) values are interpreted in relation to the "Omitted" category. This table does not include the study area fixed effects variables that are included in the model (e.g., WAOR, TXHC, NYMC). The reference case for these variables is the WAOR study area.

6.3. Model Form

To investigate the presence of Area, Scenic Vista, and Nuisance Stigmas, the adjusted annual appreciation rate (AAR) is calculated for the 354 sales pairs in the manner described in equation (10), using inflation adjusted sales prices. The following model is then estimated:

$$\text{AAR} = \beta_0 + \sum_{s} \beta_1 \text{S} + \sum_{k} \beta_2 \text{X} + \sum_{v} \beta_3 \text{VIEW} + \sum_{d} \beta_4 \text{DISTANCE} + \varepsilon \qquad (11)$$

where

AAR represents the inflation-adjusted Annual Appreciation Rate for repeat sales,

S is the vector of *s* Study Area fixed effects variables (e.g., WAOR, OKCC, etc.),

X is a vector of *k* home, site and sale characteristics (e.g., acres, square feet, original sales price),

VIEW is a vector of *v* categorical view variables (e.g., MINOR, MODERATE, etc.),

DISTANCE is a vector of *d* categorical distance variables (e.g., less than one mile, between one and three miles, etc.),

β_0 is the constant or intercept across the full sample,

β_1 is a vector of *s* parameter estimates for the study area fixed effects as compared to sales that occurred in the WAOR study area,

β_2 is a vector of *k* parameter estimates for the home, site, and sale characteristics,

β_3 is a vector of *v* parameter estimates for the VIEW variables as compared to transactions of homes with no view of the turbines,

β_4 is a vector of *d* parameter estimates for the DISTANCE variables as compared to transactions of homes outside of five miles, and

ε is a random disturbance term.

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Effectively, this model seeks to identify reasons that AARs vary among those sales pairs in the sample. Reasons for such differences in AARs might include variations in home and site characteristics, the study area in which the sale occurs, or the degree to which the home is in proximity to or has a dramatic view of a wind facility. As such, the model as shown by equation (11) has three primary groups of parameters: variables of interest; home, site, and sale characteristics; and study area fixed effects.

The variables of interest are VIEW and DISTANCE, and the coefficients β_3 and β_4 are therefore the primary focus of this analysis. Because of the small numbers of homes in the sample situated inside of 3000 feet and between 3000 feet and one mile, they are collapsed into a single category (inside one mile). For the same reason, homes with SUBSTANTIAL or EXTREME VIEWS are collapsed into a single category (SUBSTANTIAL/EXTREME). In this model, therefore, the influence on appreciation rates of the following variables of interest is estimated: MINOR, MODERATE, and SUBSTANTIAL/EXTREME VIEWS, and less than one mile, between one and three mile, and between three and five mile DISTANCES. For the VIEW fixed-effects variables, the reference category is NO VIEW; for DISTANCE, it is homes outside of five miles. As with previous models, if effects exist, it is expected that all of the coefficients would be negative and monotonically ordered.

The number of home, site, and sale characteristics included in a repeat sales model is typically substantially lower than in a hedonic model. This is to be expected because, as discussed earlier, the repeat sales model explores variations in AARs for sales pairs from individual homes, and home and site characteristics are relatively stable over time for any individual home. Nonetheless, various characteristics have been found by others (e.g., Kiel and McClain, 1995; McCluskey and Rausser, 2003) to affect appreciation rates. For the purposes of the Repeat Sales Model, these include the number of square feet of living space (SQFT_1000), the number of acres (ACRES), the inflation-adjusted price of the home at the first sale (SalePrice96_Pre), and that sales price squared (SalePrice96_Pre_Sqr). Of those characteristics, the SQFT_1000 and ACRES coefficients are expected to be positive indicating that, all else being equal, an increase in living area and lot size increases the relative appreciation rate. Conversely, it is expected that the combined estimated effect of the initial sales prices (SalePrice96_Pre and SalePrice96_Pre_Sqr) will trend downward, implying that as the initial sales price of the house increases the appreciation rate decreases. These expectations are in line with the previous literature (Kiel and McClain, 1995; McCluskey and Rausser, 2003).

Finally, the study-area fixed effects variables (β_1) are included in this model to account for differences in inflation adjusted appreciation rates that may exist across study areas (e.g., WAOR, TXHC, NYMC). The WAOR study area is the reference category, and all study-area coefficients therefore represent the marginal change in AARs compared to WAOR (the intercept represents the marginal change in AAR for WAOR by itself). These study area parameters provide a unique look into Area Stigma effects. Recall that the appreciation rates used in this model are adjusted for inflation by using an inflation index from the nearby municipal statistical area (MSA). These MSAs are sometimes quite far away (as much as 20 miles) and therefore would be unaffected by the wind facility. As such, any variation in the study area parameters (and the intercept) would be the result of local influences not otherwise captured in the inflation

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adjustment, and represent another test for Area Stigma; if effects exist, it is expected that the β_0 and β_1 coefficients will be negative.

As with the hedonic models presented earlier, the assumptions of homoskedasticity, absence of spatial autocorrelation, reasonably little multicollinearity, and appropriate controls for outliers are addressed as described in the associated footnote and in Appendix G.[93]

6.4. Analysis of Results

The results from the Repeat Sales Model are presented in Table 28. The model performs relatively poorly overall, with an Adjusted R^2 of just 0.19 (and an *F*-test statistic of 5.2). Other similar analyses in the literature have produced higher performance statistics but have done so with samples that are considerably larger or more homogenous than ours.[94] The low R^2 found here should not be cause for undue concern, however, given the relatively small sample spread across ten different study areas. Moreover, many of the home and site characteristics are found to be statistically significant, and of the appropriate sign. The coefficient for the adjusted initial sales price (SalePrice96_Pre), for example, is statistically significant, small, and negative (-0.000001, *p* value 0.00), while the coefficient for the adjusted initial sales price squared (SalePrice96_Pre_Sqr) is also statistically significant and considerably smaller (<0.000000, *p* value 0.00). These results imply, consistent with the prior literature, that for those homes in the sample, an increase in initial adjusted sales price decreases the average percentage appreciation rate. ACRES (0.002, *p* value 0.10) and SQFT_1000 (0.02, *p* value 0.00) are both positive, as expected, and statistically significant.

Of particular interest are the intercept term and the associated study-area fixed effect coefficients, and what they collectively say about Area Stigma. The coefficient for the intercept (β_0) is 0.005 (*p* value 0.81), which is both extremely small and not statistically significant. Likewise, the study-area fixed effects are all relatively small (less than 0.03 in absolute terms) and none are statistically significant. As discussed above, if a pervasive Area Stigma existed, it would be expected to be represented in these coefficients. Because all are small and statistically insignificant, it can again be concluded that there is no persuasive evidence of an Area Stigma among this sample of home transactions.

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[93] All results are produced using White's corrected standard errors to control for heteroskedasticity. Spatial autocorrelation, with this small sample, is impossible to control. Because of the small sample, an even smaller number of neighboring sales exist, which are required to construct the spatial matrix. As such, spatial autocorrelation is not addressed in the repeat sales model. As with the hedonic models, some multicollinearity might exist, but that multicollinearity is unlikely to be correlated with the variables of interest. Outliers are investigated and dealt with as discussed in footnote 91 on page 56.

[94] McCluskey and Rausser (2003) had a sample of over 30,000 repeat sales and had an *F*-test statistic of 105; Kiel and McClain (1995) produced an R^2 that ranged from 0.40 to 0.63 with samples ranging from 53 to 145, but all sales took place in North Andover, MA.

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Table 28: Results from Repeat Sales Model

	Coef.	SE	p Value	*n*
Intercept	0.005	0.02	0.81	354
WAOR	Omitted	Omitted	Omitted	6
TXHC	-0.01	0.02	0.63	57
OKCC	0.03	0.02	0.11	102
IABV	0.02	0.02	0.14	59
ILLC	-0.01	0.02	0.38	18
WIKCDC	0.02	0.03	0.50	8
PASC	-0.01	0.02	0.67	32
PAWC	0.02	0.02	0.16	35
NYMCOC	0.02	0.02	0.23	24
NYMC	0.03	0.02	0.13	13
SalePrice96_Pre	-0.000001	0.0000002	0.00	354
SalePrice96_Pre_Sqr	0.0000000	0.0000000	0.00	354
Acres	0.002	0.001	0.10	354
Sqft_1000	0.02	0.01	0.00	354
No View	Omitted	Omitted	Omitted	305
Minor View	-0.02	0.01	0.02	35
Moderate View	0.03	0.03	0.29	5
Substantial/Extreme View	-0.02	0.01	0.09	9
Less than 1 Mile	0.03	0.01	0.01	14
Between 1 and 3 Miles	0.01	0.01	0.59	199
Between 3 and 5 Miles	0.01	0.01	0.53	116
Outside 5 Miles	Omitted	Omitted	Omitted	25

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	11
Dependent Variable	SalePrice96_AAR
Number of Cases	354
Number of Predictors (k)	19
F Statistic	5.2
Adjusted R2	0.19

Turning to the variables of interest, mixed results (see Figure 9 and Figure 10) are found. For homes with MINOR or SUBSTANTIAL/EXTREME VIEWS, despite small sample sizes, appreciation rates after adjusting for inflation are found to decrease by roughly 2% annually (*p* values of 0.02 and 0.09, respectively) compared to homes with NO VIEW. Though these findings initially seem to suggest the presence of Scenic Vista Stigma, the coefficients are not monotonically ordered, counter to what one might expect: homes with a MODERATE rated view appreciated on average 3% annually (*p* value 0.29) compared to homes with NO VIEW. Adding to the suspicion of these VIEW results, the DISTANCE coefficient for homes situated inside of one mile, where eight out of the nine SUBSTANTIAL/EXTREME rated homes are located, is positive and statistically significant (0.03, *p* value 0.01). If interpreted literally, these results suggest that a home inside of one mile with a SUBSTANTIAL/EXTREME rated view would experience a decrease in annual appreciation of 2% compared to homes with no views of turbines, but simultaneously would experience an increase of 3% in appreciation compared to homes outside of five miles. Therefore, when compared to those homes outside of five miles and with no view of the wind facilities, these homes would experience an overall increase in AAR by 1%. These results are counterintuitive and are likely driven by the small number of sales pairs

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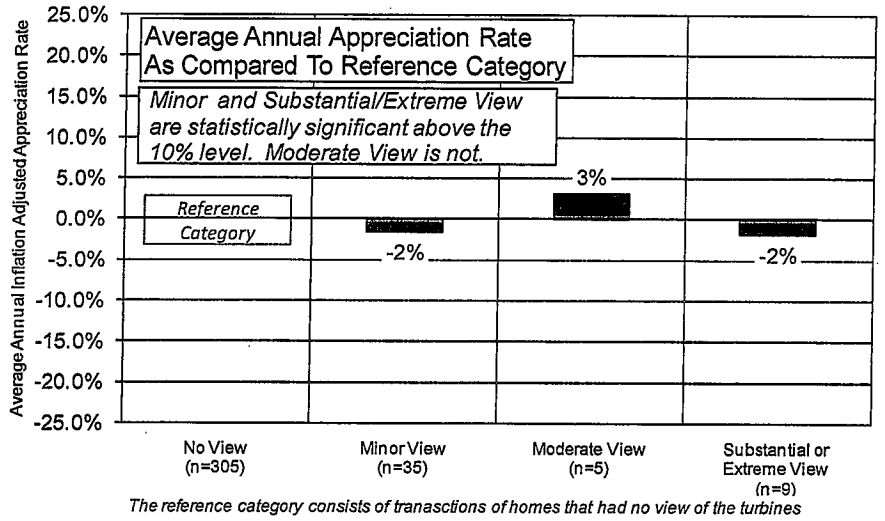
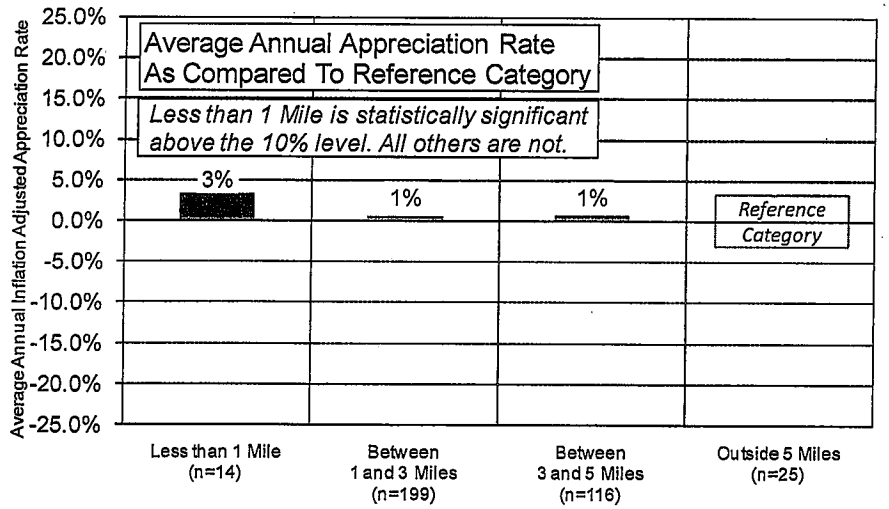
that are located within one mile of the wind turbines and experience a dramatic view of those turbines.

Figure 9: Repeat Sales Model Results for VIEW



The reference category consists of tranasctions of homes that had no view of the turbines

Figure 10: Repeat Sales Model Results for DISTANCE



The reference category consists of tranasctions of homes that are situated outside of five miles from the nearest turbine

Regardless of the reason for this result, again no persuasive evidence of consistent and widespread adverse effects is found from the presence of the wind facilities in the sample, reinforcing the findings from the previous hedonic analysis. Specifically, there is no evidence that an Area Stigma exists in that homes outside of one mile and inside of five miles do not appreciate differently than homes farther away. Similarly, there is no evidence of a Nuisance Stigma. Appreciation rates for homes inside of one mile are not adversely affected; in fact, significantly higher appreciation rates are found for these homes than for those homes located outside of five miles from the nearest wind facility. Finally, though some evidence is found that a Scenic Vista Stigma may exist in the sample of repeat sales, it is weak, fairly small, and

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somewhat counter-intuitive. This result is likely driven by the small number of sales pairs that are located within one mile of the wind turbines and that experience a dramatic view of those turbines.

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7. Sales Volume Analysis

The analysis findings to this point suggest that, among the sample of sales transactions analyzed in this report, wind facilities have had no widespread and statistically identifiable impact on residential property values. A related concern that has not yet been addressed is that of sales volume: does the presence of wind facilities either increase or decrease the rate of home sales transactions? On the one hand, a decrease in sales volumes might be expected. This might occur if homeowners expect that their property values will be impacted by the presence of the wind facility, and therefore simply choose not to sell their homes as a result, or if they try to sell but are not easily able to find willing buyers. Alternatively, an increase in sales volume might be expected if homeowners that are located near to or have a dominating view of wind turbines are uncomfortable with the presence of those turbines. Though those homes may sell at a market value that is not impacted by the presence of the wind facilities, self-selection may lead to accelerated transaction volumes shortly after facility announcement or construction as homeowners who view the turbines unfavorably sell their homes to individuals who are not so stigmatized. To address the question of whether and how sales volumes are impacted by nearby wind facilities, sales volumes are analyzed for those homes located at various distances from the wind facilities in the sample, during different facility development periods.

7.1. Dataset

To investigate whether sales volumes are affected by the presence of wind facilities two sets of data are assembled: (1) the number of homes available to sell annually within each study area, and (2) the number of homes that actually did sell annually in those areas. Homes potentially "available to sell" are defined as all single family residences within five miles of the nearest turbine that are located on a parcel of land less than 25 acres in size, that have only one residential structure, and that had a market value (for land and improvements) above $10,000.[95] Homes that "did sell" are defined as every valid sale of a single family residence within five miles of the nearest turbine that are located on a parcel of land less than 25 acres in size, that have only one residential structure, and that sold for more than $10,000.

The sales data used for this analysis are slightly different from those used in the hedonic analysis reported earlier. As mentioned in Section 3.3, a number of study areas were randomly sampled to limit the transactions outside of 3 miles if the total number of transactions were to exceed that which could efficiently be visited in the field (n ~1,250). For the sales volume analysis, however, field data collection was not required, and all relevant transactions could therefore be used. Secondly, two study areas did not provide the data necessary for the sales volume analysis (WAOR and OKCC), and are therefore excluded from the sample. Finally, data for some homes that were "available to sell" were not complete, and rather than including only a small selection of these homes, these subsets of data were simply excluded from the analysis. These excluded homes include those located outside of five miles of the nearest wind turbine, and those available to sell or that did sell more than three years before wind facility announcement.[96] The resulting

[95] "Market value" is the estimated price at which a home would sell as of a given point in time.

[96] For instance, some providers supplied sales data out to ten miles, but only provided homes available to sell out to five miles. As well, data on homes that did sell were not consistently available for periods many years before announcement.

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dataset spans the period starting three years prior to facility announcement and ending four years after construction. All homes in this dataset are situated inside of five miles, and each is located in one of the eight represented study areas.[97]

The final set of homes potentially "available to sell" and that actually "did sell" are then segmented into three distance categories: inside of one mile, between one and three miles, and between three and five miles. For each of these three distance categories, in each of the eight study areas, and for each of the three years prior to announcement, the period between announcement and construction, and each of the four years following construction, the number of homes that sold as a percentage of those available to sell is calculated.[98] This results in a total of 24 separate sales volume calculations in each study area, for a total of 192 calculations across all study areas. Finally, these sales volumes are averaged across all study areas into four development period categories: less than three years before announcement, after announcement but before construction, less than two years after construction, and between two and four years after construction.[99] The resulting average annual sales volumes, by distance band and development period, are shown in Table 29 and Figure 11.

Table 29: Sales Volumes by PERIOD and DISTANCE

	Inside 1 Mile	Between 1 and 3 Miles	Between 3 and 5 Miles
Less Than 3 Years Before Announcement	2.2%	1.8%	2.3%
After Announcement Before Construction	3.0%	2.5%	3.7%
Less Than 2 Years After Construction	2.1%	3.0%	4.2%
Between 2 and 4 Years After Construction	2.8%	2.8%	4.2%

[97] The number of homes "available to sell" is constructed for each year after 1996 based on the year the homes in each study area were built. For many homes in the sample, the year built occurred more than three years before wind facility announcement, and therefore those homes are "available to sell" in all subsequent periods. For some homes, however, the home was built during the wind facility development process, and therefore becomes "available" some time after the first period of interest. For those homes, the build year is matched to the development dates so that it becomes "available" during the appropriate period. For this reason, the number of homes "available to sell" increases in later periods.

[98] For the period after announcement and before construction, which in all study areas was not exactly 12 months, the sales volume numbers are adjusted so that they corresponded to an average over a 12 month period.

[99] These temporal groupings are slightly different from those used in the hedonic Temporal Aspects Model. Namely, the period before announcement is not divided into two parts – more than two years before announcement and less than two years before announcement – but rather only one – less than three years before announcement. This simplification is made to allow each of the interaction categories to have enough data to be meaningful.

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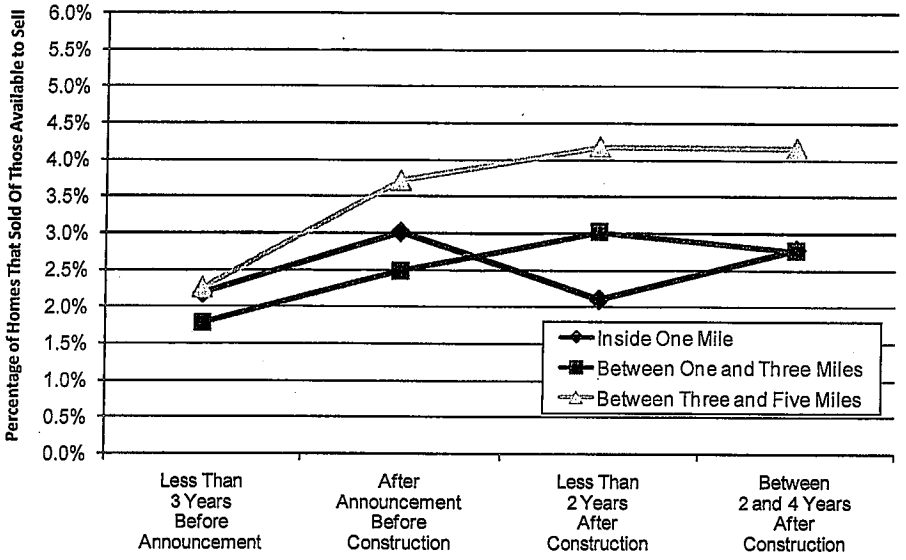
Figure 11: Sales Volumes by PERIOD and DISTANCE



7.2. Model Form

To investigate whether the rate of sales transactions is measurably affected by the wind facilities, the various resulting sales volumes shown above in Table 29 and Figure 11 are compared using a *t*-Test, as follows:

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \qquad (12)$$

where

$\bar{x}_1$ and $\bar{x}_2$ are the mean sales volumes from the two categories being compared,

s_1^2 and s_2^2 are variances of the sales volumes from the two categories being compared, and

n_1 and n_2 are numbers of representative volumes in the two categories.[100]

The degrees of freedom used to calculate the *p*-value of the *t* statistic equals the lower of $(n_1 - 1)$ or $(n_2 - 1)$.

Three sets of *t*-Tests are conducted. First, to test whether sales volumes have changed with time and are correlated with wind facility construction, the volumes for each DISTANCE group in later periods (x_1) are compared to the volume in that same group in the pre-announcement period (x_2). Second, to test whether sales volumes are impacted by distance to the nearest wind turbine, the volumes for each PERIOD group at distances closer to the turbines (x_1) are compared to the volume in that same group in the three to five mile distance band (x_2). Finally, for reasons that will become obvious later, the sales volumes for each PERIOD group at distances within one

[100] The number of representative volumes could differ between the two categories. For instance, the "less than three years before announcement" category represents three years – and therefore three volumes – for each study area for each distance band, while the "less than two years after construction" category represents two years – and therefore two volumes – for each study area for each distance band.

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mile and outside of three miles of the turbines (x_1) are compared to the sales volume in that same group in the one to three mile distance band (x_2). These three tests help to evaluate whether sales volumes are significantly different after wind facilities are announced and constructed, and whether sales volumes near the turbines are affected differently than for those homes located farther away.[101]

7.3. Analysis of Results

Table 29 and Figure 11 above show the sales volumes in each PERIOD and DISTANCE category, and can be interpreted as the percentage of homes that are available to sell that did sell in each category, on an annual average basis. The sales volume between one and three miles and before facility announcement is the lowest, at 1.8%, whereas the sales volumes for homes located between three and five miles in both periods following construction are the highest, at 4.2%.

The difference between these two sales volumes can be explained, in part, by two distinct trends that are immediately noticeable from the data presented in Figure 11. First, sales volumes in all periods are highest for those homes located in the three to five mile distance band. Second, sales volumes at virtually all distances are higher after wind facility announcement than they were before announcement.[102]

To test whether these apparent trends are borne out statistically the three sets of *t*-Tests described earlier are performed, the results of which are shown in Table 30, Table 31, and Table 32. In each table, the difference between the subject volume (x_1) and the reference volume (x_2) is listed first, followed by the *t* statistic, and whether the statistic is significant at or above the 90% level ("*").

Table 30 shows that mean sales volumes in the post-announcement periods are consistently greater than those in the pre-announcement period, and that those differences are statistically significant in four out of the nine categories. For example, the post-construction sales volumes for homes in the three to five mile distance band in the period less than two years after construction (4.2%) and between three and four years after construction (4.2%) are significantly greater than the pre-announcement volume of 2.3% (1.9%, $t = 2.40$; 1.9%, $t = 2.31$). Similarly, the post-construction sales volumes between one and three miles are significantly greater than the pre-announcement volume. These statistically significant differences, it should be noted, could be as much related to the low reference volume (i.e., sales volume in the period less than

[101] An alternative method to this model would be to pool the homes that "did sell" with the homes "available to sell" and construct a Discrete Choice Model where the dependent variable is zero (for "no sale") or one (for "sale") and the independent variables would include various home characteristics and the categorical distance variables. This would allow one to estimate the probability that a home sells dependent on distance from the wind facility. Because home characteristics data for the homes "available to sell," was not systematically collected it was not possible to apply this method to the dataset.

[102] It is not entirely clear why these trends exist. Volumes may be influenced upward in areas farther from the wind turbines, where homes, in general, might be more densely sited and homogenous, both of which might be correlated with greater home sales transactions. The converse might be true in more rural areas, nearer the wind turbines, where homes may be more unique or homeowners less prone to move. The increasing sales volumes seen in periods following construction, across all distance bands, may be driven by the housing bubble, when more transactions were occurring in general.

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three years before announcement), as they are to the sales volumes to which the reference category is compared. Finally, when comparing post-construction volumes inside of a mile, none are statistically different than the 2.2% pre-announcement level.

Table 30: Equality Test of Sales Volumes between PERIODS

	Inside 1 Mile	Between 1 and 3 Miles	Between 3 and 5 Miles
Less Than 3 Years Before Announcement	Reference	Reference	Reference
After Announcement Before Construction	0.8% (0.72)	0.7% (0.99)	1.5% (1.49)
Less Than 2 Years After Construction	-0.1% (-0.09)	1.2% (2.45) *	1.9% (2.4) *
Between 2 and 4 Years After Construction	0.6% (0.54)	1% (2.24) *	1.9% (2.31) *

Numbers in parenthesis represent t-Test statistics. "" = significantly different at or below the 10% level*

Turning to sales volumes in the same development period but between the different distance bands, consistent but less statistically significant results are uncovered (see Table 31). Although all sales volumes inside of three miles, for each period, are less than their peers outside of three miles, those differences are statistically significant in only two out of eight instances. Potentially more important, when one compares the sales volumes inside of one mile to those between one and three miles (see Table 32), small differences are found, none of which are statistically significant. In fact, on average, the sales volumes for homes inside of one mile are greater or equal to the volumes of those homes located between one and three miles in two of the three post-announcement periods. Finally, it should be noted that the volumes for the inside one mile band, in the period immediately following construction, are less than those in the one to three mile band in the same period. Although not statistically significant, this difference might imply an initial slowing of sales activity that, in later periods, returns to more normal levels. This possibility is worth investigating further and is therefore recommended for future research.

Table 31: Equality Test of Volumes between DISTANCES using 3-5 Mile Reference

	Inside 1 Mile	Between 1 and 3 Miles	Between 3 and 5 Miles
Less Than 3 Years Before Announcement	-0.1% (-0.09)	-0.5% (-0.88)	Reference
After Announcement Before Construction	-0.7% (-0.56)	-1.2% (-1.13)	Reference
Less Than 2 Years After Construction	-2.1% (-2.41) *	-1.2% (-1.48)	Reference
Between 2 and 4 Years After Construction	-1.4% (-1.27)	-1.4% (-1.82) *	Reference

Numbers in parenthesis represent t-Test statistics. "" = significantly different at or below the 10% level*

Table 32: Equality Test of Sales Volumes between DISTANCES using 1-3 Mile Reference

	Inside 1 Mile	Between 1 and 3 Miles	Between 3 and 5 Miles
Less Than 3 Years Before Announcement	0.4% (0.49)	Reference	0.5% (0.88)
After Announcement Before Construction	0.5% (0.47)	Reference	1.2% (1.13)
Less Than 2 Years After Construction	-0.9% (-1.38)	Reference	1.2% (1.48)
Between 2 and 4 Years After Construction	0% (0.01)	Reference	1.4% (1.82) *

Numbers in parenthesis represent t-Test statistics. "" = significantly different at or below the 10% level*

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Taken together, these results suggest that sales volumes are not conclusively affected by the announcement and presence of the wind facilities analyzed in this report. At least among this sample, sales volumes increased in all distance bands after the announcement and construction of the wind facilities. If this result was driven by the presence of the wind facilities, however, one would expect that such impacts would be particularly severe for those homes in close proximity to wind facilities. In other words, sales volumes would be the most affected inside of one mile, where views of the turbines are more frequent and where other potential nuisances are more noticeable than in areas farther away. This is not borne out in the data - no statistically significant differences are found for sales volumes inside of one mile as compared to those between one and three miles, and sales volumes outside of three miles are higher still. Therefore, on the whole, this analysis is unable to find persuasive evidence that wind facilities have a widespread and identifiable impact on overall residential sales volumes. It is again concluded that neither Area nor Nuisance Stigma are in evidence in this analysis.

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8. Wind Projects and Property Values: Summary of Key Results

This report has extensively investigated the potential impacts of wind power facilities on the value (i.e., sales prices) of residential properties that are in proximity to and/or that have a view of those wind facilities. In so doing, three different potential impacts of wind projects on property values have been identified and analyzed: Area Stigma, Scenic Vista Stigma, and Nuisance Stigma. To assess these potential impacts, a primary (Base) hedonic model has been applied, seven alternative hedonic models have been explored, a repeat sales analysis has been conducted, and possible impacts on sales volumes have been evaluated. Table 33 outlines the resulting ten tests conducted in this report, identifies which of the three potential stigmas those tests were designed to investigate, and summarizes the results of those investigations. This section synthesizes these key results, organized around the three potential stigmas.

Table 33: Impact of Wind Projects on Property Values: Summary of Key Results

	Is there statistical evidence of:			
Statistical Model	**Area Stigma?**	**Scenic Vista Stigma?**	**Nuisance Stigma?**	**Section Reference**
Base Model	No	No	No	*Section 4*
View Stability	Not tested	No	Not tested	*Section 5.1*
Distance Stability	No	Not tested	No	*Section 5.1*
Continuous Distance	No	No	No	*Section 5.2*
All Sales	No	No	Limited	*Section 5.3*
Temporal Aspects	No	No	No	*Section 5.4*
Orientation	No	No	No	*Section 5.5*
Overlap	No	Limited	No	*Section 5.6*
Repeat Sales	No	Limited	No	*Section 6*
Sales Volume	No	Not tested	No	*Section 7*

"No"..... No statistical evidence of a negative impact
"Yes"..... Strong statistical evidence of a negative impact
"Limited"..... Limited and inconsistent statistical evidence of a negative impact
"Not tested"..... This model did not test for this stigma

8.1. Area Stigma

Area Stigma is defined as a concern that the general area surrounding a wind energy facility will appear more developed, which may adversely affect home values in the local community regardless of whether any individual home has a view of the wind turbines. Though these impacts might be expected to be especially severe at close range to the turbines, the impacts could conceivably extend for a number of miles around a wind facility. Modern wind turbines are visible from well outside of five miles in many cases, so if an Area Stigma exists, it is possible that all of the homes in the study areas inside of five miles would be affected.

As summarized in Table 33, Area Stigma is investigated with the Base, Distance Stability, Continuous Distance, All Sales, Temporal Aspects, Orientation, and Overlap hedonic models. It is also tested, somewhat differently, with the Repeat Sales and Sales Volume analyses. In each case, if an Area Stigma exists, it is expected that the sales prices (and/or sales volume) of homes

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located near wind facilities would be broadly affected by the presence of those facilities, with effects decreasing with distance.

The Base Model finds little evidence of an Area Stigma, as the coefficients for the DISTANCE variables are all relatively small and none are statistically different from zero. For homes in this sample, at least, there is no statistical evidence from the Base Model that the distance from a home to the nearest wind turbine impacts sales prices, regardless of the distance band. Perhaps a more direct test of Area Stigma, however, comes from the Temporal Aspects Model. In this model, homes in all distance bands that sold after wind facility announcement are found to sell, on average, for prices that are not statistically different from those for homes that sold more than two years prior to wind facility announcement. Again, no persuasive evidence of an Area Stigma is evident.

The Repeat Sales and Sales Volume Models also investigate Area Stigma. The Repeat Sales Model's 354 homes, each of which sold once before facility announcement and again after construction, show average inflation-adjusted annual appreciation rates that are small and not statistically different from zero. If homes in all study areas were subject to an Area Stigma, one would expect a negative and statistically significant intercept term. Similarly, if homes in any individual study area experienced an Area Stigma, the fixed effect terms would be negative and statistically significant. Neither of these expectations is borne out in the results. The Sales Volume Model tells a similar story, finding that the rate of residential transactions is either not significantly different between the pre- and post-announcement periods, or is greater in later periods, implying, in concert with the other tests, that increased levels of transactions do not signify a rush to sell, and therefore lower prices, but rather an increase in the level of transactions with no appreciable difference in the value of those homes.

The All Sales, Distance Stability, Continuous Distance, Orientation, and Overlap Models corroborate these basic findings. In the All Sales and Distance Stability Models, for example, the DISTANCE coefficients for homes that sold outside of one mile but within five miles, compared to those that sold outside of five miles, are very similar: they differ by no more than 2%, and this small disparity is not statistically different from zero. The same basic findings resulted from the Orientation and Overlap Models. Further, homes with No View as estimated in the All Sales Model are found to appreciate in value, after adjusting for inflation, when compared to homes that sold before wind facility construction (0.02, p value 0.06); an Area Stigma effect should be reflected as a negative coefficient for this parameter. Finally, despite using all 4,937 cases in a single distance variable and therefore having a correspondingly small standard error, the Continuous Distance Model discovers no measurable relationship between distance from the nearest turbine and the value of residential properties.

Taken together, the results from these models are strikingly similar: there is no evidence of a widespread and statistically significant Area Stigma among the homes in this sample. Homes in these study areas are not, on average, demonstrably and measurably stigmatized by the arrival of a wind facility, regardless of when they sold in the wind project development process and regardless of whether those homes are located one mile or five miles away from the nearest wind facility.

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Drawing from the previous literature on environmental disamenities discussed in Section 2.1, one likely explanation for this result is simply that any effects that might exist may have faded to a level indistinguishable from zero at distances outside of a mile from the wind facilities. For other disamenities, some of which would seemingly be more likely to raise concerns, effects have been found to fade quickly with distance. For example, property value effects near a chemical plant have been found to fade outside of two and a half miles (Carroll et al., 1996), near a lead smelter (Dale et al., 1999) and fossil fuel plants (Davis, 2008) outside of two miles, and near landfills and confined animal feeding operations outside of 2,400 feet and 1,600 feet, respectively (Ready and Abdalla, 2005). Further, homes outside of 300 feet (Hamilton and Schwann, 1995) or even as little as 150 feet (Des-Rosiers, 2002) from a high voltage transmission line have been found to be unaffected. A second possible explanation for these results could be related to the view of the turbines. In the sample used for this analysis, a large majority of the homes outside of one mile ($n = 4{,}812$) that sold after wind-facility construction commenced cannot see the turbines ($n = 4{,}189$, 87%), and a considerably larger portion have – at worst – a minor view of the turbines ($n = 4{,}712$, 98%). Others have found that the sales prices for homes situated at similar distances from a disamenity (e.g., HVTL) depend, in part, on the , view of that disamenity (Des-Rosiers, 2002). Similarly, research has sometimes found that annoyance with a wind facility decreases when the turbines cannot be seen (Pedersen and Waye, 2004). Therefore, for the overwhelming majority of homes outside of a mile that have either a minor rated view or no view at all of the turbines, the turbines may simply be out of sight, and therefore, out of mind.

8.2. Scenic Vista Stigma

Scenic Vista Stigma is defined as concern that a home may be devalued because of the view of a wind energy facility, and the potential impact of that view on an otherwise scenic vista. It has as its basis an admission that home values are, to some degree, derived from the quality of what can be seen from the property and that if those vistas are altered, sales prices might be measurably affected. The Base, View Stability, Continuous Distance, All Sales, Temporal Aspects, Orientation, Overlap, and Repeat Sales Models each test whether Scenic Vista Stigma is present in the sample.

The Base Model, as well as subsequent Alternative Hedonic Models, demonstrates persuasively that the quality of the scenic vista – absent wind turbines – impacts sales prices. Specifically, compared to homes with an AVERAGE VISTA, those having a POOR or a BELOW AVERAGE rating are estimated to sell for 21% (p value 0.00) and 8% (p value 0.00) less, on average. Similarly, homes with an ABOVE AVERAGE or PREMIUM rating are estimated to sell for 10% (p value 0.00) and 13% (p value 0.00) more than homes with an AVERAGE vista rating. Along the same lines, homes in the sample with water frontage or situated on a cul-de-sac sell for 33% (p value 0.00) and 10% (p value 0.00) more, on average, than those homes that lack these characteristics. Taken together, these results demonstrate that home buyers and sellers consistently take into account what can be seen from the home when sales prices are established, and that the models presented in this report are able to clearly identify those impacts.[103]

[103] Of course, cul-de-sacs and water frontage bestow other benefits to the home owner beyond the quality of the scenic vista, such as safety and privacy in the case of a cul-de-sac, and recreational potential and privacy in the case of water frontage.

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Despite this finding, those same hedonic models are unable to identify a consistent and statistically significant Scenic Vista Stigma associated with wind facilities. Home buyers and sellers, at least among this sample, do not appear to be affected in a measurable way by the visual presence of wind facilities. Regardless of which model was estimated, the value of homes with views of turbines that were rated MODERATE, SUBSTANTIAL, or EXTREME are found to be statistically indistinguishable from the prices of homes with no view of the turbines. Specifically, the 25 homes with EXTREME views in the sample, where the home site is "unmistakably dominated by the [visual] presence of the turbines," are not found to have measurably different property values, and neither are the 31 homes with a SUBSTANTIAL view, where "the turbines are dramatically visible from the home."[104] The same finding holds for the 106 homes that were rated as having MODERATE views of the wind turbines. Moreover, the Orientation and Overlap Models show that neither the orientation of the home with respect to the view of wind turbines, nor the overlap of that view with the prominent scenic vista, have measurable impacts on home prices.

The All Sales Model compares homes with views of the turbines (in the post-construction period) to homes that sold before construction (when no views were possible), and finds no statistical evidence of adverse effects within any VIEW category. Moreover, when a *t*-Test is performed to compare the NO VIEW coefficient to the others, none of the coefficients for the VIEW ratings are found to be statistically different from the NO VIEW homes. The Repeat Sales Model comes to a similar result, with homes with MODERATE views appreciating at a rate that was not measurably different from that of homes with no views (0.03, *p* value 0.29). The same model also finds that homes with SUBSTANTIAL/EXTREME views appreciate at a rate 2% slower per year (*p* value 0.09) than their NO VIEW peers. Homes situated inside of one mile, however, are found to appreciate at a rate 3% more (*p* value 0.01) than reference homes located outside of five miles. Eight of the nine homes situated inside of one mile had either a SUBSTANTIAL or EXTREME view. Therefore, to correctly interpret these results, one would add the two coefficients for these homes, resulting in a combined 1% increase in appreciation as compared to the reference homes situated outside of five miles with no view of turbines, and again yielding no evidence of a Scenic Vista Stigma.

Although these results are consistent across most of the models, there are some individual coefficients from some models that differ. Specifically, homes with MINOR rated views in the Overlap and Repeat Sales Models are estimated to sell for 3% less (*p* value 0.10) and appreciate at a rate 2% less (*p* value 0.02) than NO VIEW homes. Taken at face value, these MINOR VIEW findings imply that homes where "turbines are visible, but, either the scope is narrow, there are many obstructions, or the distance between the home and the facility is large" are systematically impacted in a modest but measurable way. Homes with more dramatic views of a wind facility in the same models, on the other hand, are found to not be measurably affected. Because of the counterintuitive nature of this result, and because it is contradicted in the results of other models presented earlier, it is more likely that there is some aspect of these homes that was not modeled appropriately in the Overlap and Repeat Sales Models, and that the analysis is picking up the effect of omitted variable(s) rather than a systematic causal effect from the wind facilities.

[104] See Section 3.2.3 and Appendix C for full description of VIEW ratings.

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Taken together, the results from all of the models and all of the VIEW ratings support, to a large degree, the Base Model findings of no evidence of a Scenic Vista Stigma. Although there are 160 residential transactions in the sample with more dramatic views than MINOR, none of the model specifications is able to find any evidence that those views of wind turbines measurably impacted average sales prices, despite the fact that those same models consistently find that home buyers and sellers place value on the quality of the scenic vista.

8.3. Nuisance Stigma

Nuisance Stigma is defined as a concern that factors that may occur in close proximity to wind turbines, such as sound and shadow flicker, will have a unique adverse influence on home values. If these factors impact residential sales prices, those impacts are likely to be concentrated within a mile of the wind facilities. The Base, Distance Stability, Continuous Distance, All Sales, Temporal Aspects, Orientation, Overlap, Repeat Sales, and Sales Volume Models all investigate the possible presence of a Nuisance Stigma.

The Base Model finds that those homes within 3000 feet and those between 3000 feet and one mile of the nearest wind turbine sold for roughly 5% less than similar homes located more than five miles away, but that these differences are not statistically significant (p values of 0.40 and 0.30, respectively). These results remain unchanged in the Distance Stability Model, as well as in the Orientation and Overlap Models. Somewhat similarly, in the All Sales Model, when all transactions occurring after wind facility announcement are assumed to potentially be impacted (rather than just those occurring after construction, as in the Base Model), and a comparison is made to the average of all transactions occurring pre-announcement (rather than the average of all transactions outside of five miles, as in the Base Model), these same coefficients grow to -6% (p value 0.23) and -8% (p value 0.08) respectively. Although only one of these coefficients was statistically significant, they are large enough to warrant further scrutiny.

The Temporal Aspects Model provides a clearer picture of these findings. It finds that homes that sold prior to wind facility announcement and that were situated within one mile of where the turbines were eventually located sold, on average, for between 10% and 13% less than homes located more than five miles away and that sold in the same period. Therefore, the homes nearest the wind facility's eventual location were already depressed in value before the announcement of the facility. Most telling, however, is what occurred after construction. Homes inside of one mile are found to have inflation-adjusted sales prices that were either statistically undistinguishable from, or in some cases greater than, pre-announcement levels. Homes sold in the first two years after construction, for example, have higher prices (0.07, p value 0.32), as do those homes that sold between two and four years after construction (0.13, p value 0.06) and more than four years after construction (0.08, p value 0.24). In other words, there is no indication that these homes experienced a decrease in sales prices after wind facility construction began. Not only does this result fail to support the existence of a Nuisance Stigma, but it also indicates that the relatively large negative coefficients estimated in the Base and All Sales Models are likely caused by conditions that existed prior to wind facility construction and potentially prior to facility announcement.[105]

[105] See footnote 82 on page 46 for a discussion of possible alternative explanations to this scenario.

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These results are corroborated by the Continuous Distance Model, which finds no statistically significant relationship between an inverse DISTANCE function and sales prices (-0.01, sig 0.46). Similarly, in the Repeat Sales Model, homes within one mile of the nearest turbine are not found to be adversely affected; somewhat counter-intuitively, they are found to appreciate faster (0.03, *p* value 0.01) than their peers outside of five miles. Finally, the Sales Volume analysis does not find significant and consistent results that would suggest that the ability to sell one's home within one mile of a wind facility is substantially impacted by the presence of that facility.

Taken together, these models present a consistent set of results: the sales prices of homes in this sample that are within a mile of wind turbines, where various nuisance effects have been posited, are not measurably affected compared to those homes that are located more than five miles away from the facilities or that sold well before the wind projects were announced. These results imply that widespread Nuisance Stigma effects are either not present in the sample, or are too small or sporadic to be statistically identifiable.

Though these results may appear counterintuitive, it may simply be that property value impacts fade rapidly with distance, and that few of the homes in the sample are close enough to the subject wind facilities to be substantially impacted. As discussed earlier, studies of the property value impacts of high voltage transmission lines often find that effects fade towards zero at as little distance as 200 feet (see, e.g., Gallimore and Jayne, 1999; Watson, 2005). None of the homes in the present sample are closer than 800 feet to the nearest wind turbine, and all but eight homes are located outside of 1000 feet of the nearest turbine. It is therefore possible that, if any effects do exist, they exist at very close range to the turbines, and that those effects are simply not noticeable outside of 800 feet. Additionally, almost half of the homes in the sample that are located within a mile of the nearest turbine have either no view or a minor rated view of the wind facilities, and some high voltage transmission line (HVTL) studies have found a decrease in adverse effects if the towers are <u>not</u> visible (Des-Rosiers, 2002) and, similarly, decreases in annoyance with wind facility sounds if turbines cannot be seen (Pedersen and Waye, 2004). Finally, effects that existed soon after the announcement or construction of the wind facilities might have faded over time. More than half of the homes in the sample sold more than three years after the commencement of construction, while studies of HVTLs have repeatedly found that effects fade over time (Kroll and Priestley, 1992) and studies of attitudes towards wind turbines have found that such attitudes often improve after facility construction (Wolsink, 1989). Regardless of the explanation, the fact remains that, in this sizable sample of residential transactions, no persuasive evidence of a widespread Nuisance Stigma is found, and if these impacts do exist, they are either too small or too infrequent to result in any widespread and consistent statistically observable impact.

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9. Conclusions

Though surveys generally show that public acceptance towards wind energy is high, a variety of concerns with wind development are often expressed at the local level. One such concern that is often raised in local siting and permitting processes is related to the potential impact of wind projects on the property values of nearby residences.

This report has investigated the potential impacts of wind power facilities on the sales prices of residential properties that are in proximity to and/or that have a view of those wind facilities. It builds and improve on the previous literature that has investigated these potential effects by collecting a large quantity of residential transaction data from communities surrounding a wide variety of wind power facilities, spread across multiple parts of the U.S. Each of the homes included in this analysis was visited to clearly determine the degree to which the wind facility was visible at the time of home sale and to collect other essential data. To frame the analysis, three potentially distinct impacts of wind facilities on property values are considered: Area, Scenic Vista, and Nuisance Stigma. To assess these potential impacts, the authors applied a base hedonic model, explored seven alternative hedonic models, conducted a repeat sales analysis, and evaluated possible impacts on sales volumes. The result is the most comprehensive and data-rich analysis to date on the potential impacts of wind projects on nearby property values.

Although each of the analysis techniques used in this report has strengths and weaknesses, the results are strongly consistent in that each model fails to uncover conclusive evidence of the presence of any of the three property value stigmas. Based on the data and analysis presented in this report, no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities. Although the analysis cannot dismiss the possibility that individual or small numbers of homes have been or could be negatively impacted, if these impacts do exist, they are either too small and/or too infrequent to result in any widespread and consistent statistically observable impact. Moreover, to the degree that homes in the present sample are similar to homes in other areas where wind development is occurring, the results herein are expected to be transferable.

Finally, although this work builds on the existing literature in a number of respects, there remain a number of areas for further research. The primary goal of subsequent research should be to concentrate on those homes located closest to wind facilities, where the least amount of data are available. Additional research of the nature reported in this paper could be pursued, but with a greater number of transactions, especially for homes particularly close to wind facilities. Further, it is conceivable that cumulative impacts might exist whereby communities that have seen repetitive development are affected uniquely, and these cumulative effects may be worth investigating. A more detailed analysis of sales volume impacts may also be fruitful, as would an assessment of the potential impact of wind facilities on the length of time homes are on the market in advance of an eventual sale. Finally, it would be useful to conduct a survey of those homeowners living close to existing wind facilities, and especially those residents who have bought and sold homes in proximity to wind facilities after facility construction, to assess their opinions on the impacts of wind project development on their home purchase and sales decisions.

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References

American Wind Energy Association (AWEA) (2008) Wind Energy Siting Handbook. American Wind Energy Association, Washington, DC. February, 2008. 183 pages.

Bateman, I., Day, B. and Lake, I. (2001) The Effect of Road Traffic on Residential Property Values: A Literature Review and Hedonic Pricing Study. Prepared for Scottish Executive and The Stationary Office, Edinburgh, Scotland. January, 2001. 207 pages.

BBC Research & Consulting (BBC R&C) (2005) Wind Power Facility Siting Case Studies: Community Response. BBC Research & Consulting. Prepared for National Wind Coordinating Committee, c/o RESOLVE, Washington, DC. June, 2005. 51 pages.

Beck, D. (2004) How Hull Wind "I" Impacted Property Values in Pemberton. Letter sent to C. McCabe. July 28, 2004.

Benson, E. D., Hansen, J. L. and Aurthur L. Schwartz, J. (2000) Water Views and Residential Property Values. *The Appraisal Journal.* 68(3): 260-270.

Bishop, I. (2002) Determination of Thresholds of Visual Impact: The Case of Wind Turbines. *Environment and Planning B: Planning and Design.* 29: 707-718.

Bond, S. (2008) Attitudes Towards the Development of Wind Farms in Australia. *Journal of Environmental Health Australia.* 8(3): 19-32.

Bond, S. and Wang, K. K. (2007) The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods. *The Appraisal Journal.* 75(4): 362-370.

Bourassa, S. C., Hoesli, M. and Sun, J. (2004) What's in a View? *Environment and Planning.* 36(8): 1427-1450.

Boyle, M. A. and Kiel, K. A. (2001) A Survey of House Price Hedonic Studies of the Impact of Environmental Externalities. *Journal of Real Estate Research.* 9(2): 117-144.

Buhyoff, G. J., Miller, P. A., Roach, J. W., Zhou, D. and Fuller, L. G. (1994) An AI Methodology for Landscape Visual Assessments. *AI Applications.* 8(1): 1-13.

Carroll, T. M., Clauretie, T. M., Jensen, J. and Waddoups, M. (1996) The Economic Impact of a Transient Hazard on Property Values: The 1988 PEPCON Explosion in Henderson, Nevada. *Journal of Real Estate Finance and Economics.* 13(2): 143-167.

Case, B., Clapp, J., Dubin, R. and Rodriguez, M. (2004) Modeling Spatial and Temporal House Price Patterns: A Comparison of Four Models. *The Journal of Real Estate Finance and Economics.* 29(2): 167-191.

Clark, D. E. and Allison, T. (1999) Spent Nuclear Fuel and Residential Property Values: The Influence of Proximity, Visual Cues and Public Information. *Papers in Regional Science.* 78(4): 403-421.

Crone, T. M. and Voith, R. P. (1992) Estimating House Price Appreciation: A Comparison of Methods. *Journal of Housing Economics.* 2(4): 324-338.

Dale, L., Murdoch, J. C., Thayer, M. A. and Waddell, P. A. (1999) Do Property Values Rebound from Environmental Stigmas? Evidence from Dallas. *Land Economics.* 75(2): 311-326.

Dale Rankin et al. v. FPL Energy LLC et al. (Dale Rankin v. FPL) (2008). 42nd District Court - Taylor County TX. August 21, 2008. 11-07-00074-CV.

Daniel, T. C. and Boster, R. S. (1976) Measuring Landscape Aesthetics: The Scenic Beauty Estimation Method. Forest Service - Rocky Mountian Forest and Range Experiment Station in Fort Collins Colorado. Prepared for U.S. Department of Agriculture, Washington, D.C. 66 pages.

Davis, L. W. (2008) The Effect Of Power Plants On Local Housing Values And Rents: Evidence From Restricted Census Microdata. Prepared for Center for Energy and Environmental Policy Research (CEEPR), Cambridge, MA. June 18, 2008. 34 pages. 08-009.

DeLacy, B. (2005) Technical Memorandum: Impacts of The Kittitas Valley Wind Power Project on Local Property Values. Cushman & Wakefield of Oregon. Prepared for Sagebrush Power Partners, LLC. December 29, 2005. 15 pages. File Number 06-34001-9012.

Des-Rosiers, F. (2002) Power Lines, Visual Encumbrance and House Values: A Microspatial Approach to Impact Measurement. *Journal of Real Estate Research.* 23(3): 275-301.

Devine-Wright, P. (2004) Beyond NIMBYism: Towards an Integrated Framework for Understanding Public Perceptions of Wind Energy. *Wind Energy.* 8(2): 125 - 139.

Dubin, R. A. (1998) Spatial Autocorrelation: A Primer. *Journal of Housing Economics.* 7(4): 304 -327.

Durbin, J. and Watson, G. S. (1951) Testing for Serial Correlation in Least-Squares Regression. *Biometrika.* 38(1-2): 159-178.

Espey, M., Fakhruddin, F., Gering, L. R. and Lin, H. (2007) Living on the Edge: Residential Property Values in the Urban-Rural Interface. *Journal of Agricultural and Applied Economics.* 39(3): 689-699.

Exeter-Enterprises-Ltd. (1993) Attitudes to Wind Power: A Survey of Opinion in Cornwall and Devon. Prepared for Department of Trade and Industry as Cited in Devine-Wright (2004). ETSU Report W/13/00354/038/REP.

Farber, S. (1998) Undesirable Facilities and Property Values: A Summary of Empirical Studies. *Ecological Economics.* 24(1): 1-14.

Firestone, J. and Kempton, W. (2006) Public Opinion about Large Offshore Wind Power: Underlying Factors. *Energy Policy.* 35(3): 1584-1598.

Firestone, J., Kempton, W. and Krueger, A. (2007) Delaware Opinion on Offshore Wind Power - Interim Report. University of Delaware College of Marine and Earth Studies, Newark, DE. January, 2007. 16 pages.

Freeman, A. M. (1979) Hedonic Prices, Property Values and Measuring Environmental Benefits: A Survey of the Issues. *Scandinavian Journal of Economics.* 81(2): 154-173.

Gallimore, P. and Jayne, M. R. (1999) Public and Professional Perceptions of HVOTL Risks: The Problem of Circularity. *Journal of Property Research.* 16(3): 243-255. Cited by Elliott and Wadley, 2002.

Gipe, P. (2002) Design as if People Matter: Aesthetic Guidelines for a Wind Power Future. Section in Wind Power in View: Energy Landscapes in a Crowded World. Academic Press. Davis, CA. pp. 173-212 of 234 pages. ISBN 0-12-546334-0.

Global Wind Energy Council (GWEC) (2008) Global Wind Energy Outlook. Global Wind Energy Council, Brussels, Belgium, and Greenpeace, Amsterdam, The Netherlands. October, 2008. 60 pages.

Global Wind Energy Council (GWEC) (2009) Global Wind 2008 Report. Global Wind Energy Council, Brussels, Belgium, and Greenpeace, Amsterdam, The Netherlands. 60 pages.

Goldberger, A. S. (1991) A Course in Econometrics. Harvard University Press. Cambridge, MA. 178 pages.

Goldman, J. C. (2006) A Study in the Impact of Windmills on Property Values in Tucker County, West Virginia for the Proposed Beech Ridge Energy, L.L.C. project in Greenbrier County, West Virginia. Goldman Associates Inc. Prepared for Spilman Thomas & Battle, P.L.L.C., Charleston, WV. April, 2006. 51 pages. West Virginia Case No. 05-1590-E-CS.

00003717

Grover, D. S. (2002) Economic Impacts of Wind Power in Kittitas County, WA. ECONorthwest. Prepared for Phoenix Economic Development Group, Ellensburg, WA. November, 2002. 18 pages.

Gujarati, D. N. (2003) Basic Econometrics: Fourth Edition. McGraw-Hill/Irwin. New York, NY. 1002 pages. ISBN 0-07-233542-4.

Hamilton, S. and Schwann, G. (1995) Do High Voltage Electric Transmission Lines Affect Property Value? *Land Economics.* 71(4): 436-444.

Haughton, J., Giuffre, D., Barrett, J. and Tuerck, D. G. (2004) An Economic Analysis of a Wind Farm in Nantucket Sound. Beacon Hill Institute at Suffolk University, Boston, MA. May, 2004. 83 pages.

Hoen, B. (2006) Impacts of Windfarm Visibility on Property Values in Madison County, New York. Thesis Prepared for Masters Degree in Environmental Policy. Bard College, Annandale-On-Hudson, NY. April, 2006. 73 pages.

Jackson, T. O. (2001) The Effects of Environmental Contamination on Real Estate: A Literature Review. *Journal of Real Estate Research.* 9(2): 93-116.

Jackson, T. O. (2003) Methods and Techniques for Contaminated Property Valuation. *The Appraisal Journal.* 71(4): 311-320.

Jackson, T. O. (2005) Evaluating Environmental Stigma with Multiple Regression Analysis. *The Appraisal Journal.* 73(4): 363-369.

Jerabek, J. (2001) Property Values and their Relationship to the Town of Lincoln's Wind Turbine Projects. Letter sent to R. Bingen. January 30, 2001.

Jerabek, J. (2002) Property Values Respective to Wind Turbine Locations. Letter sent to Township of Lincoln Wind Turbine Moratorium Study Committee. January 29, 2002.

Jordal-Jorgensen, J. (1996) Visual Effect and Noise from Windmills - Quantifying and Valuation. Social Assessment of Wind Power in Denmark. J. Munksgaard and A. Larsen. Prepared for The Institute of Local Government Studies (AKF), Copenhagen, Denmark. April 1996.

Khatri, M. (2004) RICS Wind Farm Research: Impact of Wind Farms on the Value of Residential Property and Agricultural Land. Prepared for Royal Institute of Chartered Surveyors, London, UK. November 3, 2004. 11 pages.

Kiel, K. A. and McClain, K. T. (1995) The Effect Of An Incinerator Siting On Housing Appreciation Rates. *Journal of Urban Economics.* 37(3): 311-323.

Kielisch, K. (2009) Wind Turbine Impact Study: Dodge and Fond Du Lac Counties, WI. Appraisal Group One. Prepared for Calumet County Citizens for Responsible Energy (CCCRE), Calumet County, WI. September 9, 2009. 73 pages.

Kleinbaum, D. G., Kupper, L. L. and Muller, K. E. (1988) Applied Analysis and other Multivariate Methods, Second Edition. PWS-Kent. Boston, MA. 210 pages.

Kroll, C. A. and Priestley, T. (1992) The Effects of Overhead Transmission Lines on Property Values: A Review and Analysis of the Literature. Prepared for Edison Electric Institute, Washington, DC. July, 1992. 99 pages.

Leonard, T. and Murdoch, J. (forthcoming) The Neighborhood Effects of Foreclosure. *Journal of Geographical Systems.*

Leonard, T., Murdoch, J. and Thayer, M. (2008) The Price Effects of Environmental Disamenities in Residential Real-Estate Markets: A Review of the Literature. Working Paper. September, 2008: 14 pages.

00003718

LeSage, J. P. (1999) The Theory and Practice of Spatial Econometrics. University of Toledo. Toledo, Ohio. 284 pages.

Mahalanobis, P. C. (1936) On the Generalized Distance in Statistics. *Proceedings of the National Institute of Sciences of India.* 2(1): 49-55.

Mahan, B. L., Polasky, S. and Adams, R. M. (2000) Valuing Urban Wetlands: A Property Price Approach. *Land Economics.* 76(1): 100-113.

Maloy, M. A. and Dean, D. J. (2001) An Accuracy Assessment of Various GIS-Based Viewshed Delineation Techniques. *Photogrammetric Engineering and Remote Sensing.* 67(11): 1293-1298.

Malpezzi, S. (2003) Hedonic Pricing Models: A Selective and Applied Review. Section in Housing Economics and Public Policy: Essays in Honor of Duncan Maclennan. Wiley-Blackwell. Hoboken, NJ. pp. 67-85 of 328 pages. ISBN 978-0-632-06461-8.

McCann, M. S. (2008) Real Estate Impact Evaluation of the Horizon Wind Energy Proposed Rail Splitter Wind Farm. Prepared for Hinshaw & Culbertson, LLP, Rockford, IL. May, 2008. 24 pages.

McCann, R. J. (1999) A Review of the Literature on Property Value Impacts from Industrial Activities. *M. Cubed* (Working Paper): 16 pages.

McCluskey, J. J. and Rausser, G. C. (2003) Hazardous Waste Sites and Housing Appreciation Rates. *Journal of Environmental Economics and Management.* 45(2): 166-176.

National Academy of Sciences (NAS) (2007) Environmental Impacts of Wind-Energy Projects. Committee on Environmental Impacts of Wind Energy Projects - National Research Council. National Academy of Sciences. Washington, DC. 394 pages. ISBN: 0-309-10831-4.

Newman, J. (1956) The World of Mathematics, Volume 2. Simon & Schuster. New York. 1247 pages. ISBN# 0-486-41150-8.

Palmer, J. (1997) Public Acceptance Study of the Searsburg Wind Power Project - One Year Post Construction. Prepared for Vermont Environmental Research Associates, Inc., Waterbury Center, VT. December 1997. 58 pages.

Palmquist, R. B. (1982) Measuring Environmental Effects on Property Values Without Hedonic Regressions. *Journal of Urban Economics.* 11(3): 333-347.

Paul, T. (2006) Understanding and Predicting Community Responses to Wind Energy Development Applications. Thesis Prepared for Master of Science. Bard College, Annandale-on-Hudson, NY. April, 2006. 76 pages.

Pedersen, E. and Waye, K. P. (2004) Perception and Annoyance due to Wind Turbine Noise: A Dose-Response Relationship. *The Journal of the Acoustical Society of America.* 116(6): 3460-3470.

Pitt, D. G. and Zube, E. H. (1979). The Q-Sort Method: Use in Landscape Assessment Research and Landscape Planning. Presented at Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada. April 23-25, 1979.

Poletti, P. (2005) A Real Estate Study of the Proposed Forward Wind Energy Center Dodge and Fond Du Lac Counties, Wisconsin. Poletti and Associates. Prepared for Invenergy Wind LLC, Chicago, IL. May, 2005. 106 pages.

Poletti, P. (2007) A Real Estate Study of the Proposed White Oak Wind Energy Center, Mclean & Woodford Counties, Illinois. Polleti and Associates. Prepared for Invenergy Wind LLC, Chicago, IL. January, 2007. 63 pages.

00003719

Ready, R. C. and Abdalla, C. W. (2005) The Amenity and Disamenity Impacts of Agriculture: Estimates from a Hedonic Pricing Model. *American Journal of Agricultural Economics.* 87(2): 314-326.

Riggs, P. D. and Dean, D. J. (2007) An Investigation into the Causes of Errors and Inconsistencies in Predicted Viewsheds. *Transactions in GIS.* 11(2): 175-196.

Rosen, S. (1974) Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy.* 82(1): 34-55.

Schwarz, G. E. (1978) Estimating the Dimension of a Model. *Annals of Statistics.* 6(2): 461-464.

Seiler, M. J., Bond, M. T. and Seiler, V. L. (2001) The Impact of World Class Great Lakes Water Views on Residential Property Values. *The Appraisal Journal.* 69(3): 287-295.

Simons, R. (2006a) When Bad Things Happen To Good Property. Environmental Law Institute Press. Washington DC. 350 pages. ISBN: 9781585761012.

Simons, R. (2006b) Peer Reviewed Evidence on Property Value Impacts by Source of Contamination. Section in When Bad Things Happen To Good Property. Environmental Law Institute Press. Washington DC. p. 350. ISBN: 9781585761012.

Simons, R. A. and Saginor, J. D. (2006) A Meta-Analysis of the Effect of Environmental Contamination and Positive Amenities on Residential Real Estate Values. *Journal of Real Estate Research.* 28(1): 71-104.

Sims, S. and Dent, P. (2007) Property Stigma: Wind Farms Are Just The Latest Fashion. *Journal of Property Investment & Finance.* 25(6): 626-651.

Sims, S., Dent, P. and Oskrochi, G. R. (2008) Modeling the Impact of Wind Farms on House Prices in the UK. *International Journal of Strategic Property Management.* 12(4): 251-269.

Sirmans, G. S., Lynn, M., Macpherson, D. A. and Zietz, E. N. (2005a). The Value of Housing Characteristics: A Meta Analysis. Presented at Mid Year Meeting of the American Real Estate and Urban Economics Association. May 2005.

Sirmans, G. S., Macpherson, D. A. and Zietz, E. N. (2005b) The Composition of Hedonic Pricing Models. *Journal of Real Estate Literature.* 13(1): 3-42.

Sterzinger, G., Beck, F. and Kostiuk, D. (2003) The Effect of Wind Development on Local Property Values. Renewable Energy Policy Project, Washington, DC. May, 2003. 77 pages.

Thayer, M., Albers, H. and Rhamation, M. (1992) The Impact of Landfills on Residential Property Values. *Journal of Real Estate Research.* 7(3): 265-282.

Thayer, R. L. and Freeman, C. N. (1987) Altamont: Public Perceptions of a Wind Energy Landscape. *Landscape and Urban Planning.* 14(1987): 379-398.

Torres-Sibillea, A., V. Cloquell-Ballester and Darton, R. (2009) Development and Validation of a Multicriteria Indicator for the Assessment of Objective Aesthetic Impact of Wind Farms. *Renewable and Sustainable Energy Reviews.* 13(1): 40-66.

United States Department of Agriculture (USDA) (1995) Landscape Aesthetics: A Handbook for Scenic Management. United States Department of Agriculture - Forest Service, Washington, DC. December 1995.

United States Department of Energy (US DOE) (2008) 20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply. U.S. Department of Energy, Washington, DC. May, 2008. 248 pages.

00003720

Watson, M. (2005) Estimation of Social and Environmental Externalities for Electricity Infrastructure in the Northwest Sector. Reviewed by Martin Hill. Prepared for Prepared for Parsons Brinckerhoff by Integral Energy, Sydney, Australia. August 2005. 73 pages.

White, H. (1980) A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica.* 48(4): 817-838.

Wiser, R. and Bolinger, M. (2009) 2008 Wind Technologies Market Report. Lawrence Berkeley National Laboratory. Prepared for U.S. Department of Energy, Washington, DC. July, 2009. 68 pages. DOE/GO-102009-2868.

Wiser, R. and Hand, M. (2010) Wind Power: How Much, How Soon, and At What Cost? Section in Generating Electricity in a Carbon-Constrained World. Elsevier. Oxford, UK. p. 632. ISBN-13: 978-1-85617-655-2.

Wolsink, M. (1989) Attitudes and Expectancies about Wind Turbines and Wind Farms. *Wind Engineering.* 13(4): 196-206.

Wolsink, M. (2000) Wind Power and the NIMBY-Myth: Institutional Capacity and the Limited Significance of Public Support. *Renewable Energy.* 21(1): 49-64.

Zarem, K. L. (2005) Direct Testimony Regarding Forward Wind Project, Dodge and Fond Du Lac Counties, Wisconsin. Public Service Commission of Wisconsin, Madison, Wisconsin. June, 2005. 12 pages. Docket No. 9300-CE-100.

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Appendix A: Study Area Descriptions

The analysis reported in the body of the report used data from ten different wind-project study areas, across nine different states and 14 counties, and surrounding 24 different wind facilities. Each of the study areas is unique, but as a group they provide a good representation of the range of wind facility sizes, hub heights, and locations of recent wind development activity in the U.S. (see Figure A - 1 and Table A - 1). This appendix describes each of the ten study areas, and provides the following information: a map of the study area; a description of the area; how the data were collected; statistics on home sales prices in the sample and census-reported home values for the towns, county, and state that encompass the area; data on the wind facilities contained within the study area; and frequency tables for the variables of interest (i.e., views of turbines, distance to nearest turbine ,and development period).

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Figure A - 1: Map of Study Areas

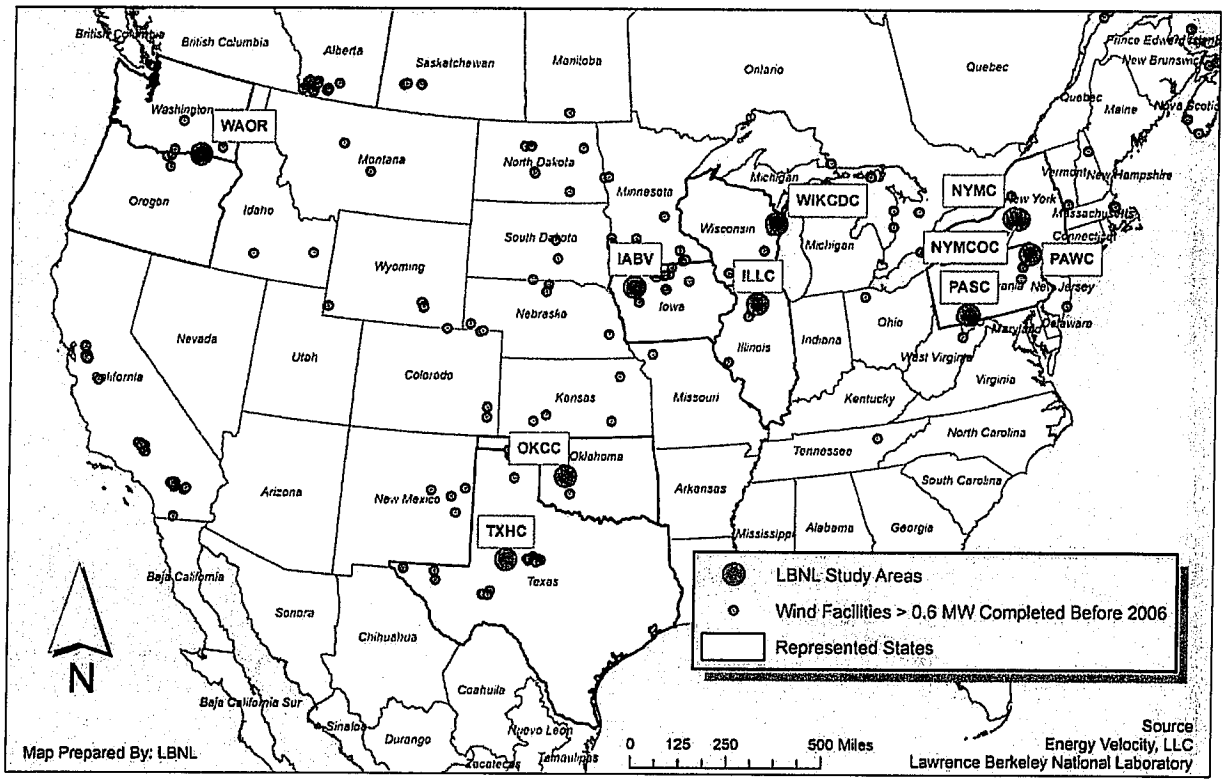

Table A - 1: Summary of Study Areas

Study Area Code	Study Area Counties, States	Facility Names	Number of Turbines	Number of MW	Max Hub Height (meters)	Max Hub Height (feet)
WAOR	Benton and Walla Walla Counties, WA and Umatilla County, OR	Vansycle Ridge, Stateline, Nine Canyon I & II, Combine Hills	582	429	60	197
TXHC	Howard County, TX	Big Spring I & II	46	34	80	262
OKCC	Custer County, OK	Weatherford I & II	98	147	80	262
IABV	Buena Vista County, IA	Storm Lake I & II, Waverly, Intrepid I & II	381	370	65	213
ILLC	Lee County, IL	Mendota Hills, GSG Wind	103	130	78	256
WIKCDC	Kewaunee and Door Counties, WI	Red River, Lincoln	31	20	65	213
PASC	Somerset County, PA	Green Mountain, Somerset, Meyersdale	34	49	80	262
PAWC	Wayne County, PA	Waymart	43	65	65	213
NYMCOC	Madison and Oneida Counties, NY	Madison	7	12	67	220
NYMC	Madison County, NY	Fenner	20	30	66	218
		TOTAL	1345	1286		

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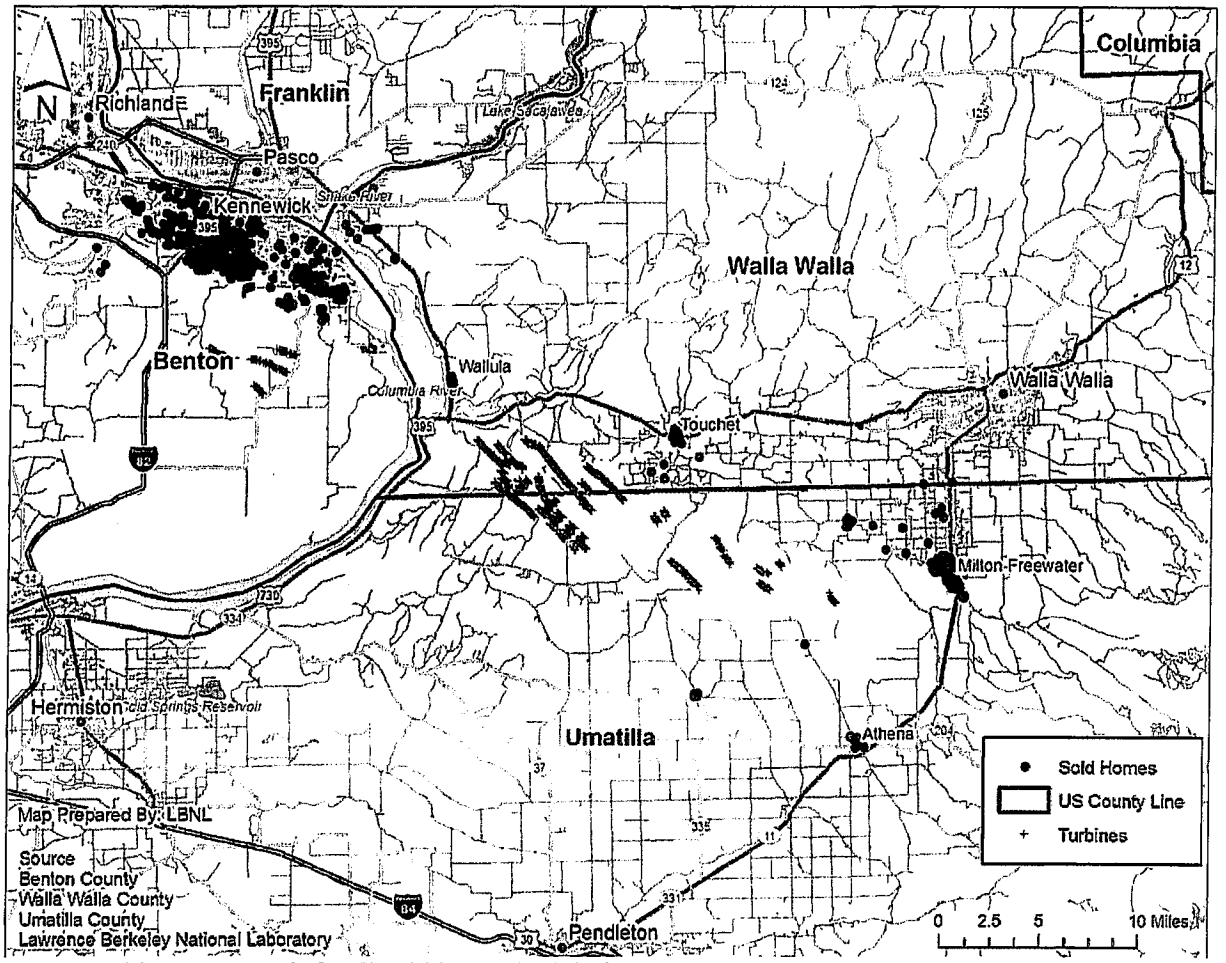
A.1 WAOR Study Area: Benton and Walla Walla Counties (Washington), and Umatilla County (Oregon)

Figure A - 2: Map of WAOR Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area combines data from the three counties - Benton and Walla Walla in Washington, and Umatilla in Oregon - that surround the Vansycle Ridge, Stateline, Combine Hills, and Nine Canyon wind projects. Wind development began in this area in 1997 and, within the sample of wind projects, continued through 2003. In total, the wind facilities in this study area include 582 turbines and 429 MW of nameplate capacity, with hub heights that range from 164 feet to almost 200 feet. The wind facilities are situated on an East-West ridge that straddles the Columbia River, as it briefly turns South. The area consists of undeveloped highland/plateau grassland, agricultural tracks for winter fruit, and three towns: Kennewick (Benton County), Milton-Freewater (Umatilla County), and Walla Walla (Walla Walla County). Only the first two of these towns are represented in the dataset because Walla Walla is situated more than 10 miles from the nearest wind turbine. Also in the area are Touchet and Wallula, WA, and Athena, OR,

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all very small communities with little to no services. Much of the area to the North and South of the ridge, and outside of the urban areas, is farmland, with homes situated on small parcels adjoining larger agricultural tracts.

Data Collection and Summary

Data for this study area were collected from a myriad of sources. For Benton County, sales and home characteristic data and GIS parcel shapefiles were collected with the assistance of county officials Eric Beswick, Harriet Mercer, and Florinda Paez, while state official Deb Mandeville (Washington Department of State) provided information on the validity of the sales. In Walla Walla County, county officials Bill Vollendorff and Tiffany Laposi provided sales, house characteristic, and GIS data. In Umatilla County, county officials Jason Nielsen, Tracie Diehl, and Tim McElrath provided sales, house characteristic, and GIS data.

Based on the data collection, more than 8,500 homes are found to have sold within ten miles of the wind turbines in this study area from January 1996 to June 2007. Completing field visits to this number of homes would have been overly burdensome; as a result, only a sample of these home sales was used for the study. Specifically, all valid sales within three miles of the nearest turbine are used, and a random sample of those homes outside of three miles but inside of five miles in Benton County and inside ten miles in Walla Walla and Umatilla Counties. This approach resulted in a total of 790 sales, with prices that ranged from $25,000 to $647,500, and a mean of $134,244. Of those 790 sales, 519 occurred after wind facility construction commenced, and 110 could see the turbines at the time of sale, though all but four of these homes had MINOR views. No homes within this sample were located within one mile of the nearest wind turbine, with the majority occurring outside of three miles.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/23/1996	6/29/2007	790	$ 125,803	$ 134,244	$ 25,000	$ 647,500

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Vansycle Ridge	25	38	Aug-97	Feb-98	Aug-98	Vestas	50
Stateline Wind Project, Phase I (OR)	83	126	Jun-00	Sep-01	Dec-01	Vestas	50
Stateline Wind Project, Phase I (WA)	177	268	Jun-00	Feb-01	Dec-01	Vestas	50
Stateline Wind Project, Phase II	40	60	Jan-02	Sep-02	Dec-02	Vestas	50
Nine Canyon Wind Farm	48	37	Jun-01	Mar-02	Sep-02	Bonus	60
Combine Hills Turbine Ranch I	41	41	Apr-02	Aug-03	Dec-03	Mitsubishi	55
Nine Canyon Wind Farm II	16	12	Jun-01	Jun-03	Dec-03	Bonus	60

Source: AWEA & Ventyx Inc.

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Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Benton/Walla Walla, WA & Umatilla, OR (WAOR)	226	45	76	59	384	790

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Benton/Walla Walla, WA & Umatilla, OR (WAOR)	271	409	106	4	0	0	790

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Benton/Walla Walla, WA & Umatilla, OR (WAOR)	271	0	0	20	277	222	790

Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Kennewich, WA	City	62,182	12.5%	2,711	32.3	$ 45,085	$ 155,531	46%
Walla Walla, WA	City	30,794	4.0%	2,847	33.8	$ 38,391	$ 185,706	91%
Milton Freewater, OR	Town	6,335	-2.0%	3,362	31.7	$ 30,229	$ 113,647	47%
Touchet, WA	Town	413	n/a	340	33.6	$ 47,268	$ 163,790	81%
Benton	County	159,414	3.6%	94	34.4	$ 51,464	$ 162,700	46%
Walla Walla	County	57,709	1.0%	45	34.9	$ 43,597	$ 206,631	89%
Umatilla	County	73,491	0.6%	23	34.6	$ 38,631	$ 138,200	47%
Washington	State	6,488,000	10.1%	89	35.3	$ 55,591	$ 300,800	79%
Oregon	State	3,747,455	9.5%	36	36.3	$ 48,730	$ 257,300	69%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

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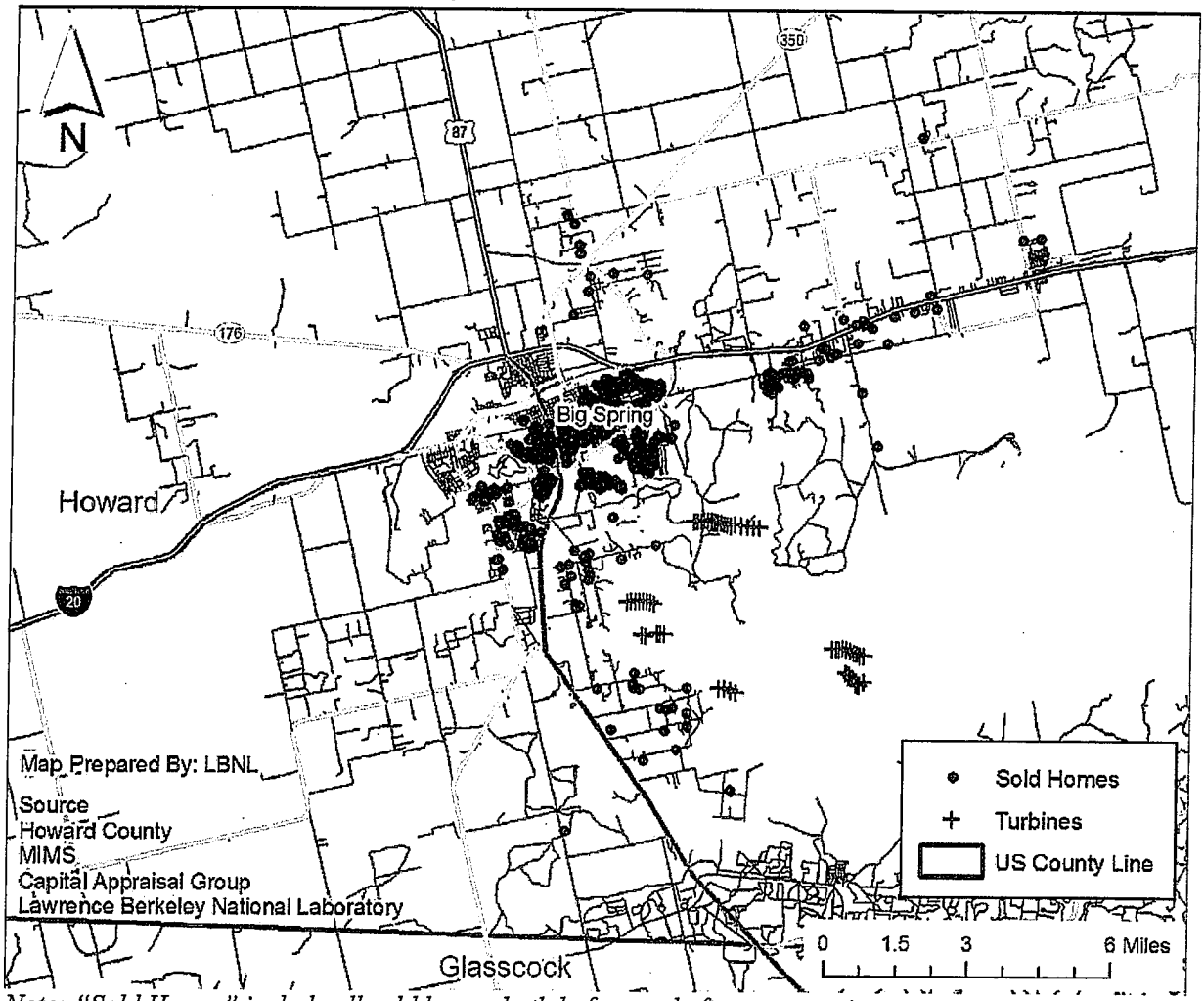
A.2 TXHC Study Area: Howard County (Texas)

Figure A - 3: Map of TXHC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area is entirely contained within Howard County, Texas, and includes the city of Big Spring, which is situated roughly 100 miles South of Lubbock and 275 miles West of Dallas in West Texas. On top of the Northern end of the Edwards Plateau, which runs from the Southeast to the Northwest, sits the 46 turbine (34 MW) Big Spring wind facility, which was constructed in 1998 and 1999. Most of the wind turbines in this project have a hub height of 213 feet, but four are taller, at 262 feet. The plateau and the wind facility overlook the city of Big Spring which, when including its suburbs, wraps around the plateau to the South and East. Surrounding the town are modest farming tracks and arid, undeveloped land. These lands, primarily to the South of the facility towards Forsan (not shown on map), are dotted with small oil rigs. Many of the homes in Big Spring do not have a view of the wind facility, but others to the South and East do have such views.

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Data Collection and Summary

County officials Brett McKibben, Sally Munoz, and Sheri Proctor were extremely helpful in answering questions about the data required for this project, and the data were provided by two firms that manage it for the county. Specifically, Erin Welch of the Capital Appraisal Group provided the sales and house characteristic data and Paul Brandt of MIMS provided the GIS data.

All valid single-family home sales transactions within five miles of the nearest turbine and occurring between January 1996 and March 2007 were included in the dataset, resulting in 1,311 sales.[106] These sales ranged in price from $10,492 to $490,000, with a mean of $74,092. Because of the age of the wind facility, many of the sales in the sample occurred after wind facility construction had commenced (n = 1,071). Of those, 104 had views of the turbines, with 27 having views more dramatic than MINOR. Four homes sold within a mile of the facility, with the rest falling between one and three miles (n = 584), three to five miles (n = 467), and outside of five miles (n = 16).

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/2/1996	3/30/2007	1,311	$66,500	$74,092	$10,492	$490,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Big Spring I	27.7	42	Jan-98	Jul-98	Jun-99	Vestas	65
Big Spring II	6.6	4	Jan-98	Jul-98	Jun-99	Vestas	80

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Howard, TX (TXHC)	169	71	113	131	827	1311

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Howard, TX (TXHC)	240	967	77	22	5	0	1311

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Howard, TX (TXHC)	240	0	4	584	467	16	1311

[106] If parcels intersected the five mile boundary, they were included in the sample, but were coded as being outside of five miles.

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Census Statistics

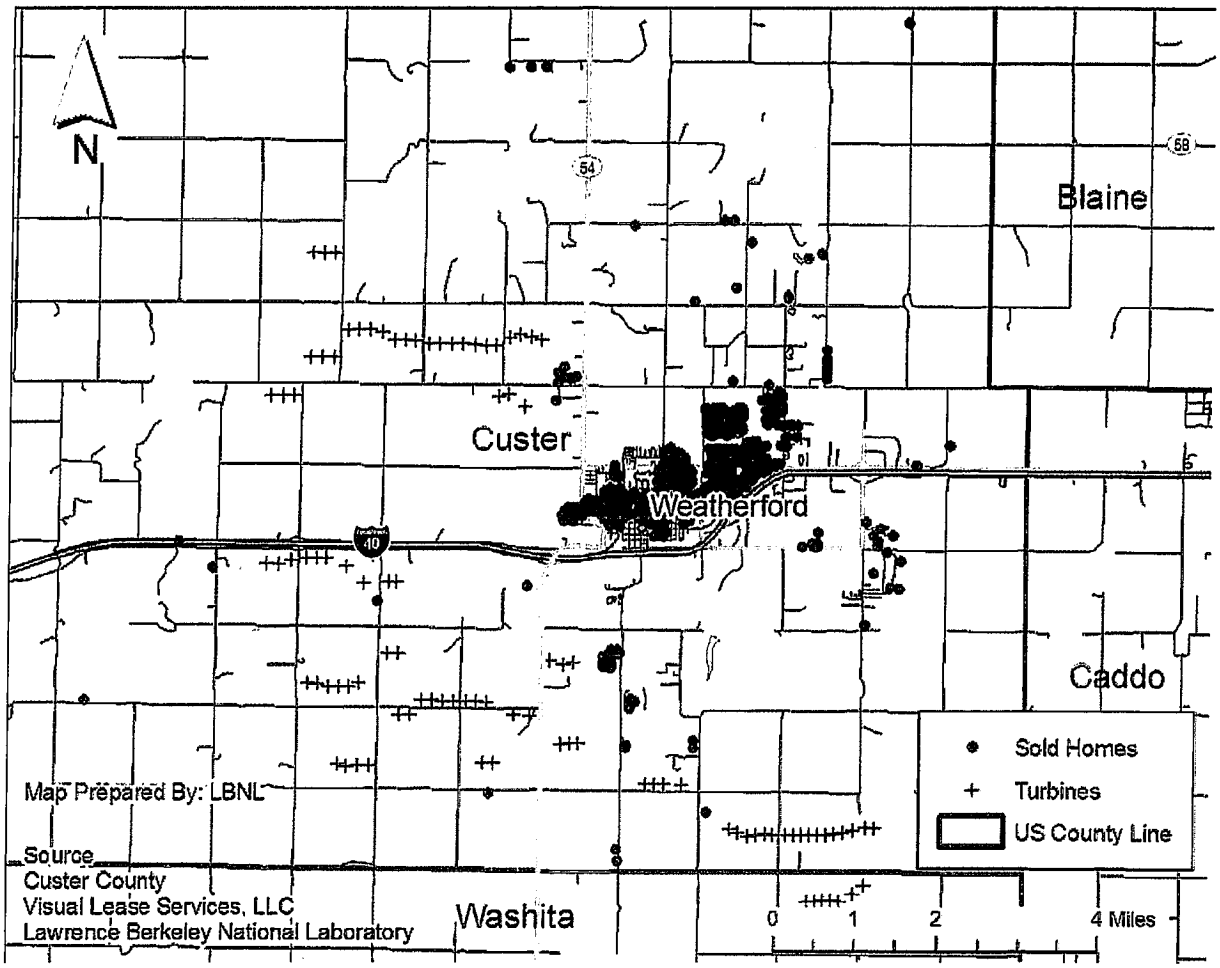
Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Big Spring	City	24,075	-5.4%	1,260	35.1	$ 32,470	$ 54,442	50%
Forsan	Town	220	-4.0%	758	36.8	$ 50,219	$ 64,277	84%
Howard	County	32,295	-1.9%	36	36.4	$ 36,684	$ 60,658	58%
Texas	State	23,904,380	14.6%	80	32.3	$ 47,548	$ 120,900	47%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants.

00003729

A.3 OKCC Study Area: Custer County (Oklahoma)

Figure A - 4: Map of OKCC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area is entirely contained within Custer County, Texas, and includes the Weatherford wind facility, which is situated near the city of Weatherford, 70 miles due west of Oklahoma City and near the western edge of the state. The 98 turbine (147 MW) Weatherford wind facility straddles Highway 40, which runs East-West, and U.S. County Route 54, which runs North-South, creating an "L" shape that is more than six miles long and six miles wide. Development began in 2004, and was completed in two phases ending in 2006. The turbines are some of the largest in the sample, with a hub height of 262 feet. The topography of the study area is mostly flat plateau, allowing the turbines to be visible from many parts of the town and the surrounding rural lands. There are a number of smaller groupings of homes that are situated to the North and South of the city, many of which are extremely close to the turbines and have dramatic views of them.

00003730

Data Collection and Summary

County Assessor Debbie Collins and mapping specialist Karen Owen were extremely helpful in gathering data and answering questions at the county level. Data were obtained directly from the county and from Visual Lease Services, Inc and OKAssessor, where representatives Chris Mask, Terry Wood, Tracy Leniger, and Heather Brown helped with the request.

All valid single-family residential transactions within five miles of the nearest wind turbine and occurring between July 1996 and June 2007 were included in the dataset, resulting in 1,113 sales.[107] These sales ranged in price from $11,000 to $468,000, with a mean of $100,445. Because of the relatively recent construction of the facility, 58% of the sales ($n = 637$) occurred before construction, leaving 476 sales with possible views of the turbines. Of those 476 sales, 25 had more-dramatic view ratings than MINOR and 17 sales occurred inside of one mile.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
7/7/1996	6/29/2007	1,113	$91,000	$100,445	$11,000	$468,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Weatherford Wind Energy Center	106.5	71	Mar-04	Dec-04	May-05	GE Wind	80
Weatherford Wind Energy Center Expansion	40.5	27	May-05	Oct-05	Jan-06	GE Wind	80

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Custer, OK (OKCC)	484	153	193	187	96	1113

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Custer, OK (OKCC)	637	375	76	6	7	12	1113

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Custer, OK (OKCC)	637	16	1	408	50	1	1113

[107] Portions of the town of Weatherford, both North and South of the town center, were not included in the sample due to lack of available data. The homes that were mapped, and for which electronic data were provided, however, were situated on all sides of these unmapped areas and were similar in character to those that were omitted. None of the unmapped homes were within a mile of the nearest wind turbine.

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Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Weatherford	City	10,097	1.2%	1,740	24.1	$ 32,543	$ 113,996	45%
Hydro	Town	1,013	-3.7%	1,675	39.2	$ 35,958	$ 66,365	68%
Custer	County	26,111	3.6%	26	32.7	$ 35,498	$ 98,949	52%
Oklahoma	State	3,617,316	4.8%	53	35.5	$ 41,567	$ 103,000	46%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants.

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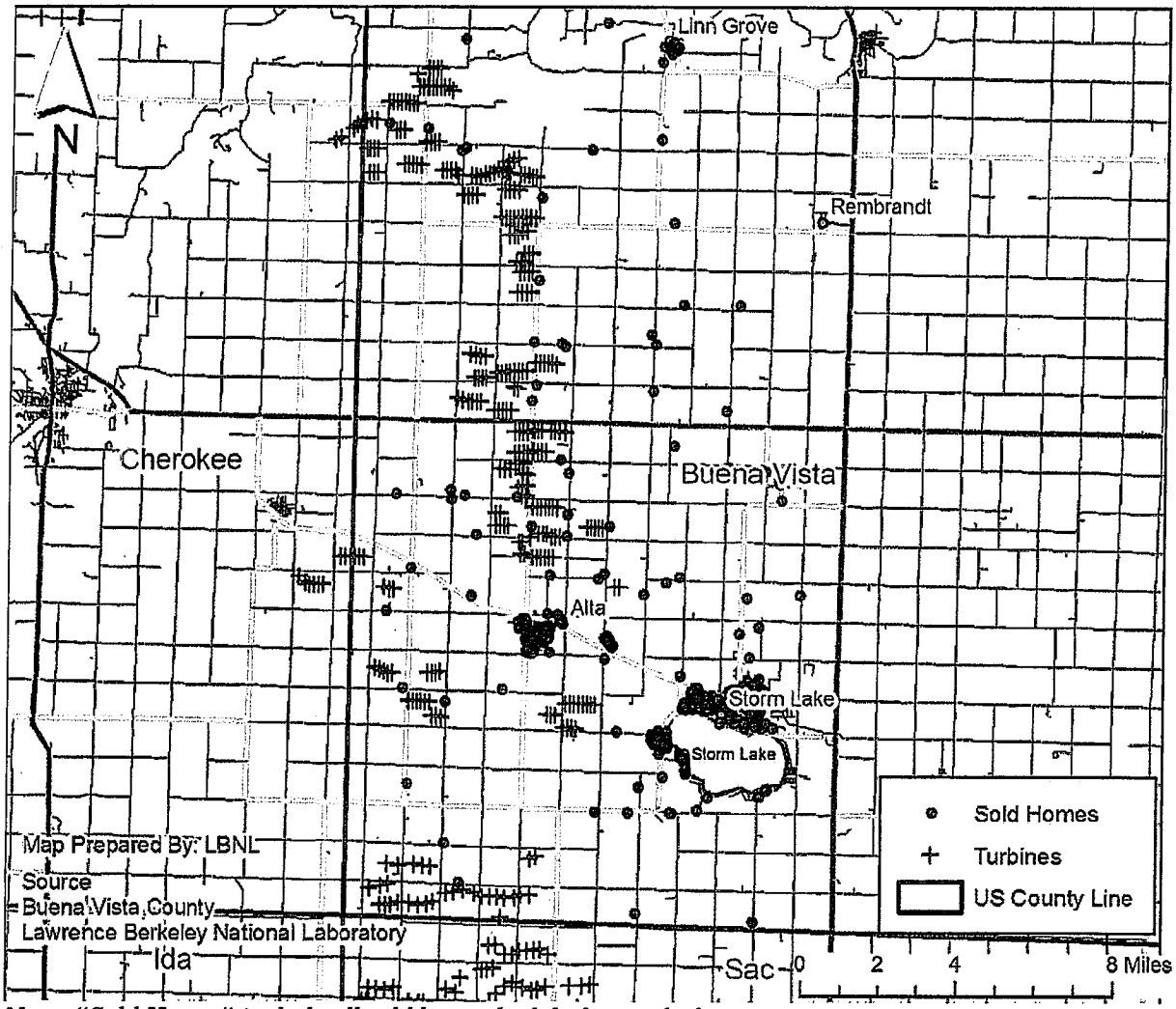
A.4 IABV Study Area: Buena Vista County (Iowa)

Figure A - 5: Map of IABV Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area includes the sizable Storm Lake and Intrepid wind facilities, which are mostly situated in Buena Vista County, located in Northwestern Iowa, 75 miles East of Sioux City. The facilities also stretch into Sac County to the South and Cherokee County to the West. The facilities total 381 turbines (370 MW) and are more than 30 miles long North to South and eight miles wide East to West. Development began on the first Storm Lake facility in 1998 and the last of the Intrepid development was completed in 2006. The largest turbines have a hub height of 213 feet at the hub, but most are slightly smaller at 207 feet. The majority of the homes in the sample surround Storm Lake (the body of water), but a large number of homes are situated on small residential plots located outside of the town and nearer to the wind facility. Additionally, a number of sales occurred in Alta - a small town to the East of Storm Lake -thatis straddled by the

00003733

wind facilities and therefore provides dramatic views of the turbines. In general, except for the depression in which Storm Lake sits, the topography is very flat, largely made up corn fields, and the turbines are therefore visible from quite far away. The housing market is driven, to some extent, by the water body, Storm Lake, which is a popular recreational tourist destination, and therefore development is occurring to the East and South of the lake. Some development is also occurring, to a lesser degree, to the East of Alta.

Data Collection and Summary

County Assessor Kathy A. Croker and Deputy Assessor Kim Carnine were both extremely helpful in answering questions and providing GIS data. Sales and home characteristic data were provided by Vanguard Appraisals, Inc., facilitated by the county officials. David Healy from MidAmerican provided some of the necessary turbine location GIS files.

The county provided data on valid single-family residential transactions between 1996 and 2007 for 1,743 homes inside of five miles of the nearest wind turbine. This sample exceeded the number for which field data could reasonably be collected; as a result, only a sample of these homes sales was used for the study. Specifically, all transactions that occurred within three miles of the nearest turbine were used, in combination with a random sample (totaling roughly 10%) of those homes between three and five miles. This approach resulted in 822 sales, with prices that ranged from $12,000 to $525,000, and a mean of $94,713. Development of the wind facilities in this area occurred relatively early in the sample period, and therefore roughly 75% of the sales (n = 605) occurred after project construction had commenced. Of those 605 sales, 105 had views of the turbines, 37 of which were ranked with a view rating more dramatic than MINOR, and 30 sales occurred within one mile of the nearest wind turbine.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/2/1996	3/30/2007	822	$79,000	$94,713	$12,000	$525,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Storm Lake I	112.5	150	Feb-98	Oct-98	Jun-99	Enron	63
Storm Lake II	80.3	107	Feb-98	Oct-98	Apr-99	Enron	63
Waverly	1.5	2	Feb-98	Oct-98	Jun-99	Enron	65
Intrepid	160.5	107	Mar-03	Oct-04	Dec-04	GE Wind	65
Intrepid Expansion	15.0	15	Jan-05	Apr-05	Dec-05	Mitsubishi	65

Source: AWEA & Ventyx Inc.

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Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Buena Vista, IA (IABV)	152	65	80	70	455	822

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Buena Vista, IA (IABV)	217	500	68	18	8	11	822

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Buena Vista, IA (IABV)	217	22	8	472	101	2	822

Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Storm Lake	City	9,706	-3.9%	2,429	31.7	$ 39,937	$ 99,312	41%
Alta	Town	1,850	-1.0%	1,766	35.1	$ 40,939	$ 98,843	48%
Buena Vista	County	19,776	-3.1%	36	36.4	$ 42,296	$ 95,437	45%
Iowa	State	3,002,555	2.6%	52	36.6	$ 47,292	$ 117,900	43%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants.

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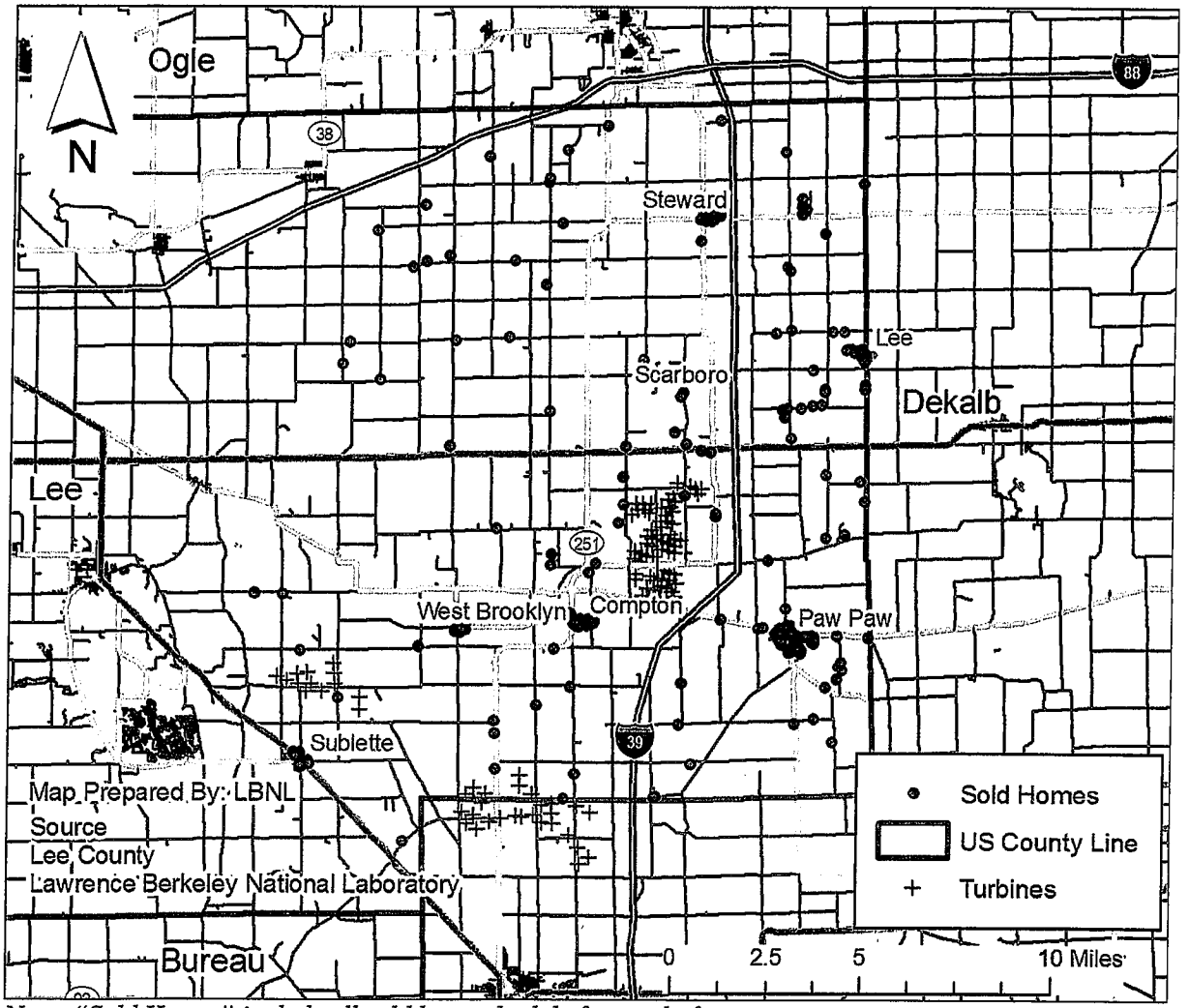
A.5 ILLC Study Area: Lee County (Illinois)

Figure A - 6: Map of ILLC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area is situated roughly 80 miles due West of Chicago, in Lee County, Illinois, and includes two wind facilities. The 63 turbine (53 MW) Mendota Hills Wind Project sits just West of North-South Highway 39, and 10 miles South of East-West Highway 88. Development began on the facility in 2001 and was completed in 2003. The second facility, the 40 turbine (80 MW) GSG Wind Farm is South and West of the Mendota Hills facility, and is broken into two parts: roughly one third of the turbines are situated two miles due north of the small town of Sublette, with the remainder located roughly six miles to the southeast and spanning the line separating Lee from La Salle County. Development began on this project in the fall of 2006 and was completed in April of the following year. The town of Paw Paw, which is East of Highway 38 and both facilities, is the largest urban area in the study area, but is further away from the

00003736

facilities than the towns of Compton, West Brooklyn, Scarboro, and Sublette. Also, to the North of the facilities are the towns of Lee, to the East of Highway 38, and Steward, just to the West. Although many home sales occurred in these towns, a significant number of additional sales occurred on small residential tracts in more-rural areas or in small developments. The topography of the area is largely flat, but falls away slightly to the East towards Paw Paw. The area enjoyed significant development during the real estate boom led by commuters from the Chicago metropolitan area, which was focused in the Paw Paw area but was also seen in semi-rural subdivisions to the Southwest and North of the wind facility.

Data Collection and Summary

County Supervisor Wendy Ryerson was enormously helpful in answering questions and providing data, as were Carmen Bollman and GIS Director, Brant Scheidecker, who also work in the county office. Wendy and Carmen facilitated the sales and home characteristic data request and Brant provided the GIS data. Additionally, real estate brokers Neva Grevengoed of LNG Realtor, Alisa Stewart of AC Corner Stone, and Beth Einsely of Einsely Real Estate were helpful in understanding the local market.

The county provided information on 412 valid single-family transactions that occurred between 1998 and 2007 within 10 miles of the nearest wind turbine, all of which were included in the sample.[108] These sales ranged in price from $14,500 to $554,148, with a mean of $128,301. Of those sales, 213 occurred after construction commenced on the wind facility and, of those, 36 had views of the turbines – nine of which were rated more dramatically than MINOR. Only two sales occurred within one mile of the nearest wind turbine.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
5/1/1998	3/2/2007	412	$113,250	$128,301	$14,500	$554,148

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Mendota Hills	50.4	63	Nov-01	Aug-03	Nov-03	Gamesa	65
GSG Wind Farm	80	40	Dec-05	Sep-06	Apr-07	Gamesa	78

Source: AWEA & Ventyx Inc.

[108] This county was not able to provide data electronically back to 1996, as would have been preferred, but because wind project development did not occur until 2001, there was ample time in the study period to establish pre-announcement sale price levels.

00003737

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Lee, IL (ILLC)	115	84	62	71	80	412

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Lee, IL (ILLC)	199	177	27	7	1	1	412

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Lee, IL (ILLC)	199	1	1	85	69	57	412

Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Paw Paw	Town	884	2.6%	1,563	38.0	$ 48,399	$ 151,954	n/a
Compton	Town	337	-2.9%	2,032	32.8	$ 44,023	$ 114,374	n/a
Steward	Town	263	-3.0%	2,116	35.2	$ 59,361	$ 151,791	n/a
Sublette	Town	445	-2.4%	1,272	37.7	$ 55,910	$ 133,328	n/a
Lee	County	35,450	-1.7%	49	37.9	$ 47,591	$ 136,778	64%
Illinois	State	12,852,548	3.5%	223	34.7	$ 54,124	$ 208,800	60%
US	Country	301,139,947	7.0%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

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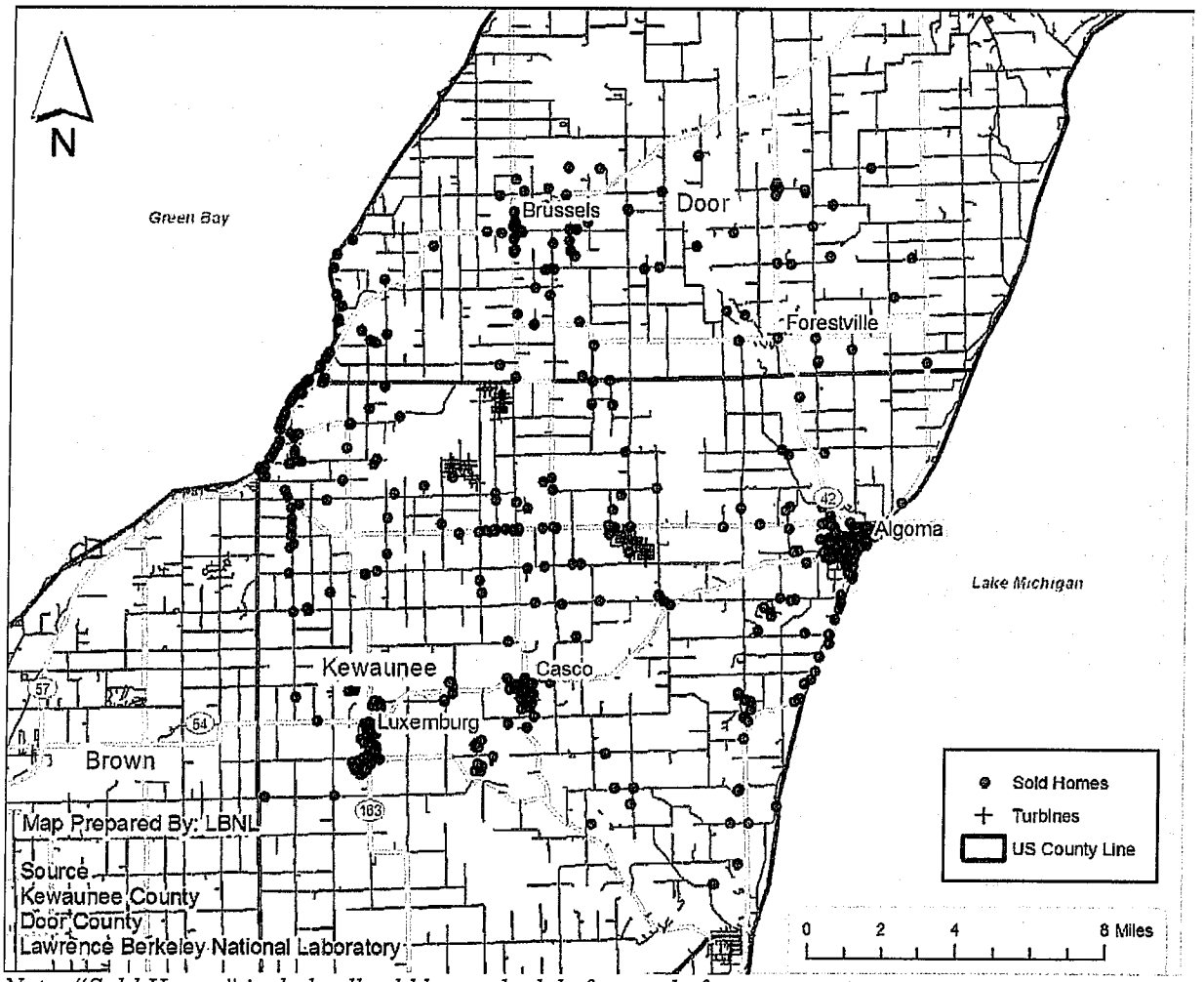
A.6 WIKCDC Study Area: Kewaunee and Door Counties (Wisconsin)

Figure A - 7: Map of WIKCDC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area includes the Red River (17 turbines, 14 MW) and Lincoln (14 turbines, 9 MW) wind facilities. It is situated on the "thumb" jutting into Lake Michigan, Northeast of Green Bay, Wisconsin, and spans two counties, Kewaunee and Door. There is a mix of agricultural, small rural residential, waterfront, and urban land use in this area. The three largest towns are Algoma to the East of the facilities and on the lake, Casco, which is six miles due South of the turbines, and Luxemburg, four miles West of Casco. There is a smaller village, Brussels, to the North in Door County. The remainder of the homes is situated on the water or in small rural residential parcels between the towns. Topographically, the "thumb" is relatively flat except for a slight crown in the middle, and then drifting lower to the edges. The East edge of the "thumb" ends in bluffs over the water, and the western edge drops off more gradually, allowing those parcels to

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enjoy small beaches and easy boat access. There is some undulation of the land, occasionally allowing for relatively distant views of the wind turbines, which stand at a hub height of 213 feet.

Data Collection and Summary

Kewaunee and Door Counties did not have a countywide system of electronic data storage for either sales or home characteristic data. Therefore, in many cases, data had to be collected directly from the town or city assessor. In Kewaunee County, Joseph A. Jerabek of the town of Lincoln, Gary Taicher of the town of Red River, Melissa Daron of the towns of Casco, Pierce, and West Kewaunee, Michael Muelver of the town of Ahnapee and the city of Algoma, William Gerrits of the town of Casco, Joseph Griesbach Jr. of the town of Luxemburg, and David Dorschner of the city of Kewaunee all provided information. In Door County, Scott Tennessen of the town of Union and Gary Maccoux of the town of Brussels were similarly very helpful in providing information. Additionally, Andy Pelkey of Impact Consultants, Inc., John Holton of Associated Appraisal Consultants, Andy Bayliss of Dash Development Group, and Lue Van Asten of Action Appraisers & Consultants all assisted in extracting data from the myriad of storage systems used at the town and city level. The State of Wisconsin provided additional information on older sales and sales validity, with Mary Gawryleski, James Bender, and Patrick Strabala from the Wisconsin Department of Revenue being extremely helpful. GIS data were obtained from Steve Hanson from Kewaunee County and Tom Haight from Door County.

After collecting data from each municipality, a total of 810 valid single-family home sales transactions were available for analysis, ranging in time from 1996 to 2007. These sales ranged in price from $20,000 to $780,000, with a mean of $116,698. Because development of the wind facilities occurred relatively early in the study period, a large majority of the sales transactions, 75% ($n = 725$), occurred after project construction had commenced. Of those, 64 had views of the turbines, 14 of which had more dramatic than MINOR views, and 11 sales occurred within one mile.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
2/2/1996	6/30/2007	810	$98,000	$116,698	$20,000	$780,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Red River	11.2	17	Apr-98	Jan-99	Jun-99	Vestas	65
Lincoln	9.2	14	Aug-98	Jan-99	Jun-99	Vestas	65

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Kewaunee/Door, WI (WIKCDC)	44	41	68	62	595	810

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Kewaunee/Door, WI (WIKCDC)	85	661	50	9	2	3	810

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Kewaunee/Door, WI (WIKCDC)	85	7	4	63	213	438	810

Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Algoma	Town	3,186	-4.7%	1,305	41.8	$ 39,344	$ 112,295	51%
Casco	Town	551	-2.8%	985	35.6	$ 53,406	$ 141,281	n/a
Luxemburg	Town	2,224	15.3%	1,076	32.0	$ 53,906	$ 167,403	n/a
Kewaunee	County	20,533	1.4%	60	37.5	$ 50,616	$ 148,344	57%
Door	County	27,811	2.4%	58	42.9	$ 44,828	$ 193,540	57%
Wisconsin	State	5,601,640	0.3%	103	36.0	$ 50,578	$ 168,800	50%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

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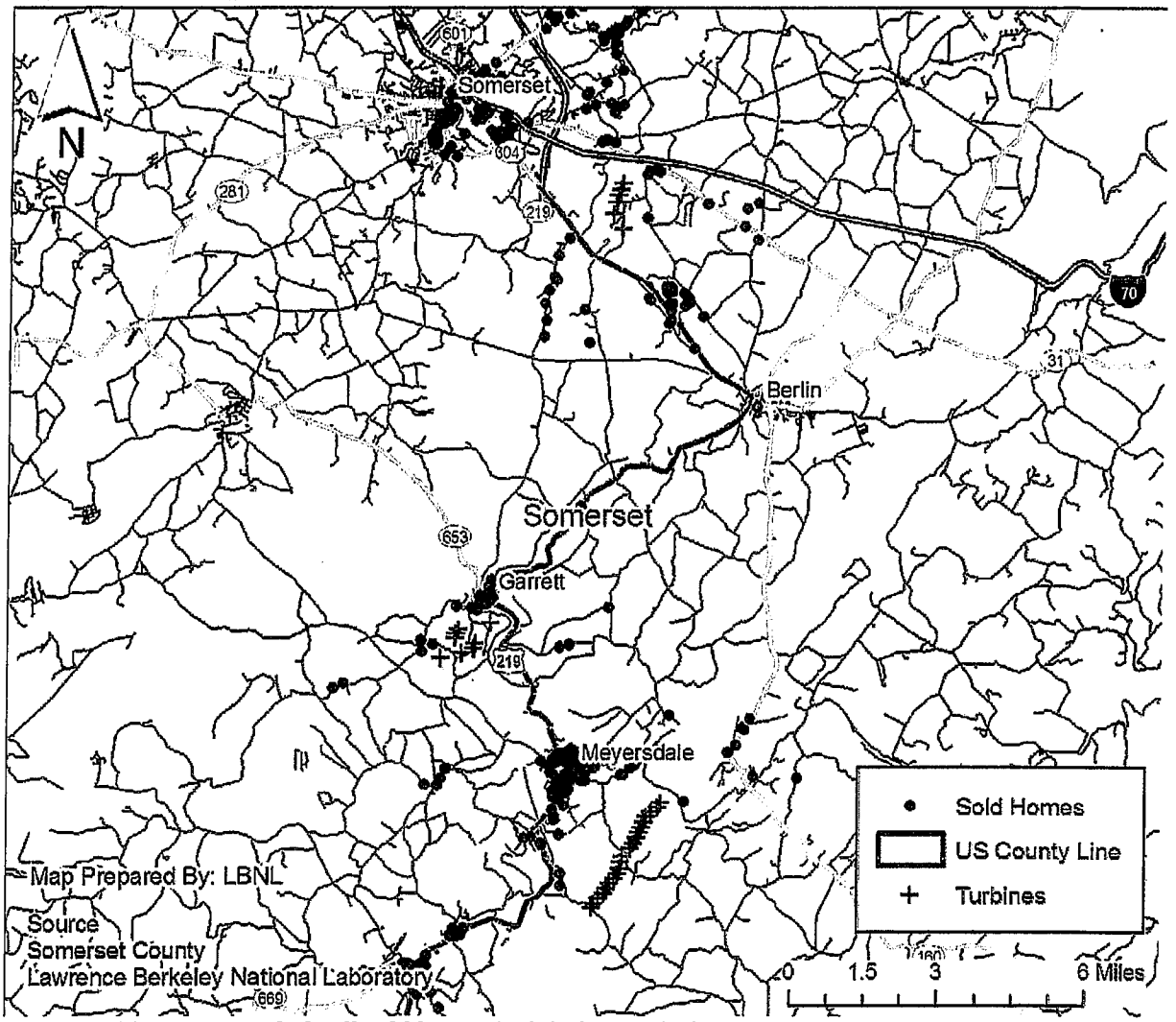
A.7 PASC Study Area: Somerset County (Pennsylvania)

Figure A - 8: Map of PASC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area includes three wind facilities, Somerset (6 turbines, 9 MW, 210 ft hub height) to the North, Meyersdale (20 turbines, 30 MW, 262 ft hub height) to the South, and Green Mountain (8 turbines, 10 MW, 197 ft hub height) between them. All of the projects are located in Somerset County, roughly 75 miles southeast of Pittsburg in the Southwest section of Pennsylvania. None of the three facilities are separated by more than 10 miles, so all were included in one study area. To the North of the facilities is East-West U.S. Highway 70, which flanks the city of Somerset. Connecting Somerset with points South is County Route 219, which zigzags Southeast out of Somerset to the smaller towns of Berlin (not included in the data), Garret to the Southwest, and Meyersdale, which is Southeast of Garret. These towns are flanked by two ridges that run from the Southwest to the Northeast. Because of these ridges and the

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relatively high elevations of all of the towns, this area enjoys winter recreation, though the coal industry, which once dominated the area, is still an integral part of the community with mining occurring in many places up and down the ridges. Although many of the home sales in the sample occurred in the towns, a number of the sales are for homes situated outside of town corresponding to either rural, rural residential, or suburban land uses.

Data Collection and Summary

The County Assessor, Jane Risso, was extremely helpful, and assisted in providing sales and home characteristic data. Glen Wagner, the IT director, worked with Gary Zigler, the county GIS specialist, to extract both GIS and assessment data from the county records. Both Gary and Jane were extremely helpful in fielding questions and providing additional information as needs arose.

The county provided a total of 742 valid residential single-family home sales transactions within four miles of the nearest wind turbine. All of the sales within three miles were used ($n = 296$), and a random sample (~ 44%) of those between three and four miles were used, yielding a total of 494 sales that occurred between May 1997 and March 2007. These sales ranged in price from $12,000 to $360,000, with a mean of $69,770. 291 sales (~ 60% of the 494) occurred after construction commenced on the nearest wind facility. Of these 291 sales, 73 have views of the turbines, 18 of which are more dramatic than MINOR, and 35 sales occurred within one mile.[109]

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
5/1/1997	3/1/2007	494	$62,000	$69,770	$12,000	$360,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
GreenMountain Wind Farm	10.4	8	Jun-99	Dec-99	May-00	Nordex	60
Somerset	9.0	6	Apr-01	Jun-01	Oct-01	Enron	64
Meyersdale	30.0	20	Jan-03	Sep-03	Dec-03	NEG Micor	80

Source: AWEA & Ventyx Inc.

[109] This study area was one of the earliest to have field work completed, and therefore the field data collection process was slower resulting in a lower number of transactions than many other study areas.

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Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Somerset, PA (PASC)	175	28	46	60	185	494

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Somerset, PA (PASC)	203	218	55	15	2	1	494

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Somerset, PA (PASC)	203	17	18	132	124	0	494

Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Somerset	Town	6,398	-4.8%	2,333	40.2	$ 35,293	$ 123,175	n/a
Berlin	Town	2,092	-4.0%	2,310	41.1	$ 35,498	$ 101,704	n/a
Garrett	Town	425	-4.7%	574	34.5	$ 29,898	$ 54,525	n/a
Meyersdale	Town	2,296	-6.6%	2,739	40.9	$ 29,950	$ 79,386	n/a
Somerset Co	County	77,861	-2.7%	72	40.2	$ 35,293	$ 94,500	41%
Pennsylvania	State	12,440,621	1.3%	277	38.0	$ 48,576	$ 155,000	60%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

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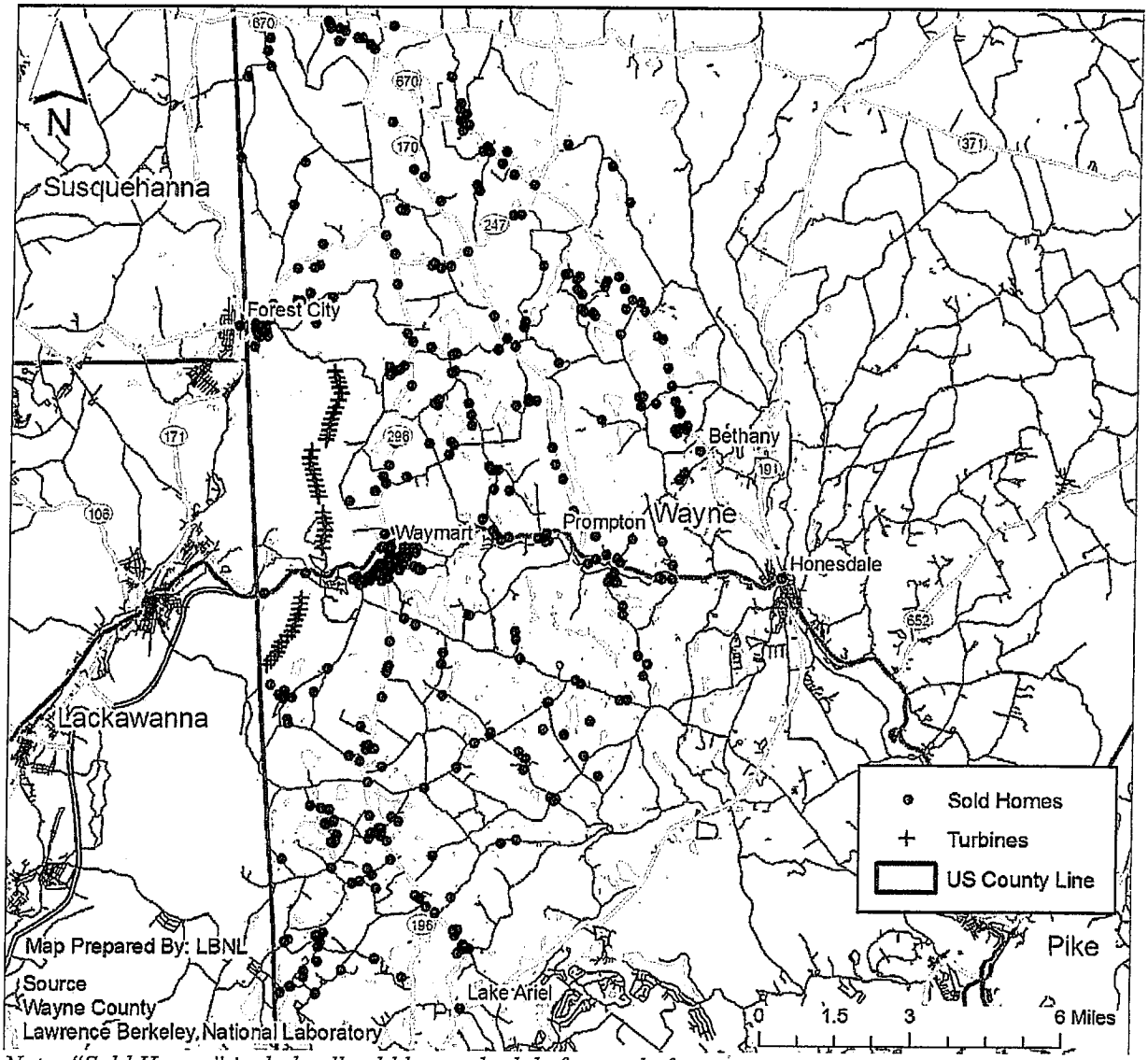
A.8 PAWC Study Area: Wayne County (Pennsylvania)

Figure A - 9: Map of PAWC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area includes the Waymart wind facility, which sits atop the North-South ridge running along the line separating Wayne County from Lackawanna and Susquehanna Counties in Northeast Pennsylvania. The 43 turbine (65 MW, 213 ft hub height) facility was erected in 2003, and can be seen from many locations in the study area and especially from the towns of Waymart, which sits East of the facility, and Forest City, which straddles Wayne and Susquehanna Counties North of the facility. The study area is dominated topographically by the ridgeline on which the wind turbines are located, but contains rolling hills and many streams, lakes, and natural ponds. Because of the undulating landscape, views of the wind facility can be

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maintained from long distances, while some homes relatively near the turbines have no view of the turbines whatsoever. The area enjoys a substantial amount of second home ownership because of the bucolic scenic vistas, the high frequency of lakes and ponds, and the proximity to larger metropolitan areas such as Scranton, roughly 25 miles to the Southwest, and Wilkes-Barre a further 15 miles Southwest.

Data Collection and Summary

John Nolan, the County Chief Assessor, was very helpful in overseeing the extraction of the data from county records. GIS specialist Aeron Lankford provided the GIS parcel data as well as other mapping layers, and Bruce Grandjean, the IT and Data Specialist, provided the sales and home characteristic data as well as fielding countless questions as they arose. Additionally, real estate brokers Dotti Korpics of Bethany, Kent Swartz of Re Max, and Tom Cush of Choice #1 Country Real Estate were instrumental providing context for understanding the local market.

The county provided data on 551 valid single-family transactions that occurred between 1996 and 2007, all of which were included in the sample. These sales ranged in price from $20,000 to $444,500, with a mean of $111,522. Because of the relatively recent development of the wind facility, only 40% ($n = 222$) of the sales transaction occurred after the construction of the facility had commenced. Of those sales, 43 (19%) had views of the turbines, ten of which had more dramatic than MINOR views, and 11 were situated within one mile.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
7/12/1996	9/25/2006	551	$96,000	$111,522	$20,000	$444,500

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Waymart Wind Farm	64.5	43	Feb-01	Jun-03	Oct-03	GE Wind	65

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Wayne, PA (PAWC)	223	106	64	71	87	551

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Wayne, PA (PAWC)	329	179	33	8	2	0	551

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Wayne, PA (PAWC)	329	1	10	95	55	61	551

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Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Waymart	Town	3,075	116.0%	1,111	41.7	$ 43,797	$ 134,651	56%
Forest City	Town	1,743	-5.2%	1,929	45.6	$ 32,039	$ 98,937	67%
Prompton	Town	237	-1.6%	149	41.9	$ 30,322	$ 162,547	56%
Wayne	County	51,708	5.9%	71	40.8	$ 41,279	$ 163,060	57%
Lackawanna	County	209,330	-1.9%	456	40.3	$ 41,596	$ 134,400	48%
Pennsylvania	State	12,440,621	1.3%	277	38.0	$ 48,576	$ 155,000	60%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants.

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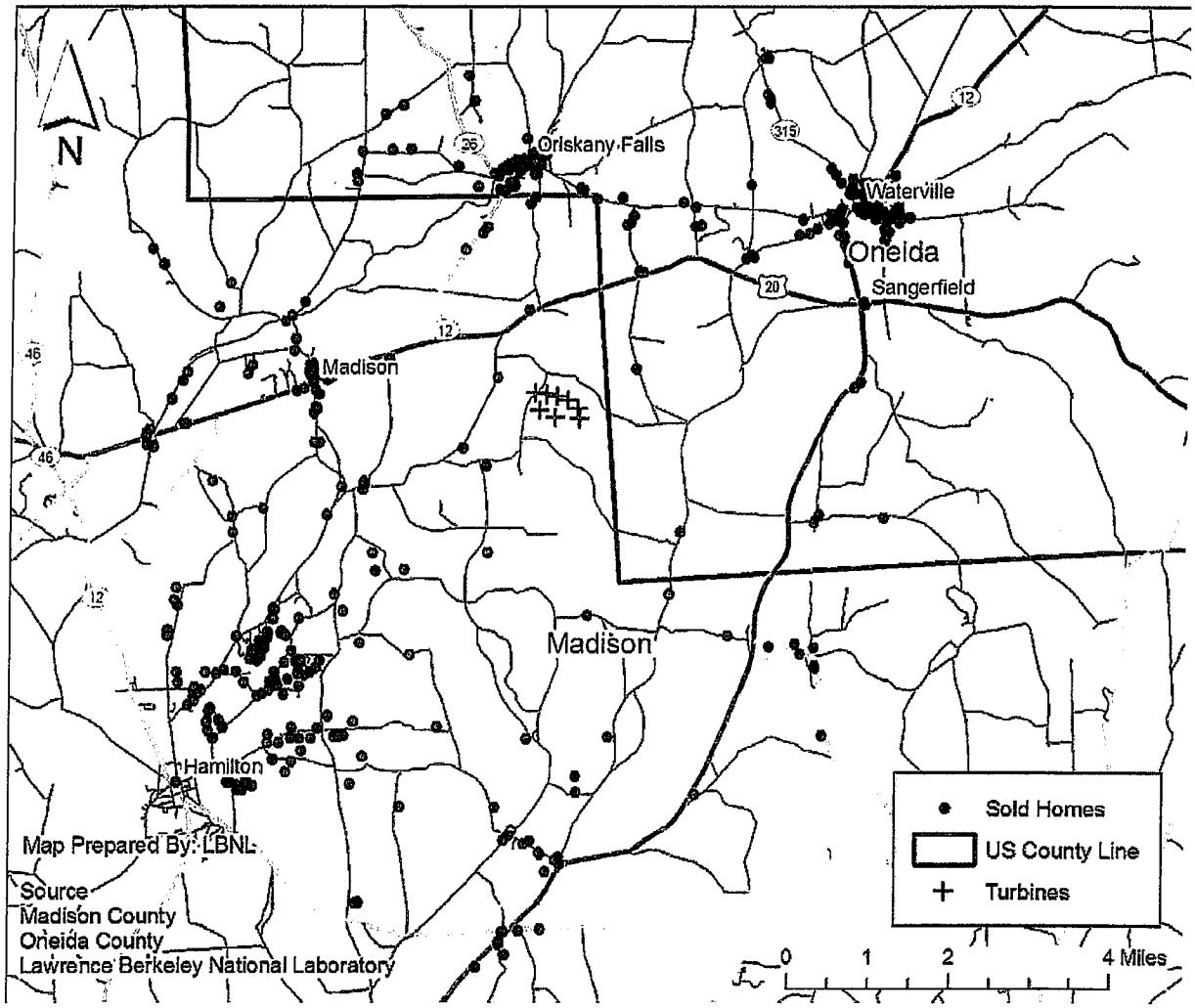
A.9 NYMCOC Study Area: Madison and Oneida Counties (New York)

Figure A - 10: Map of NYMCOC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area surrounds the seven turbine (12 MW, 220 ft hub height) Madison wind facility, which sits atop an upland rise in Madison County, New York. The area is roughly 20 miles Southwest of Utica and 40 miles Southeast of Syracuse. The facility is flanked by the towns moving from the Southwest, clockwise around the rise, from Hamilton and Madison in Madison County, NY, to Oriskany Falls, Waterville, and Sangerfield in Oneida County, NY. Hamilton is the home of Colgate University, whose staff lives throughout the area around Hamilton and stretching up into the town of Madison. Accordingly, some development is occurring near the college. To the Northeast, in Oneida County, the housing market is more depressed and less development is apparent. The study area in total is a mix of residential, rural residential, and

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rural landscapes, with the largest portion being residential homes in the towns or immediately on their outskirts. The topography, although falling away from the location of the wind facility, does not do so dramatically, so small obstructions can obscure the views of the facility.

Data Collection and Summary

Data were obtained from both Madison and Oneida Counties for this study area. In Madison County, Kevin Orr, Mike Ellis, and Carol Brophy, all of County's Real Property Tax Services Department, were extremely helpful in obtaining the sales, home characteristic, and GIS data. In Oneida County, Jeff Quackenbush and Richard Reichert in the Planning Department were very helpful in obtaining the county data. Additionally, discussions with real estate brokers Susanne Martin of Martin Real Estate, Nancy Proctor of Prudential, and Joel Arsenault of Century 21 helped explain the housing market and the differences between Madison and Oneida Counties.

Data on 463 valid sales transactions of single family residential homes that occurred between 1996 and 2006 were obtained, all of which were located within seven miles of the wind facility. These sales ranged in price from $13,000 to $380,000, with a mean of $98,420. Roughly 75% (*n* = 346) of these sales occurred after construction commenced on the wind facility, of which 20 could see the turbines, all of which were rated as having MINOR views, except one which had a MODERATE rating; only two sales involved homes that were situated inside of one mile.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/6/1996	12/26/2006	463	$77,500	$98,420	$13,000	$380,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Madison Windpower	11.6	7	Jan-00	May-00	Sep-00	Vestas	67

Source: AWEA & Ventyx Inc.

Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Madison/Oneida, NY (MYMCOC)	108	9	48	30	268	463

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Madison/Oneida, NY (MYMCOC)	117	326	19	1	0	0	463

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Madison/Oneida, NY (MYMCOC)	117	1	1	80	193	71	463

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Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Madison	Town	304	-2.9%	605	38.1	$ 36,348	$ 94,734	n/a
Hamilton	Town	3,781	7.9%	1,608	20.8	$ 48,798	$ 144,872	n/a
Orinkany Fal	Town	1,413	-2.9%	1,703	40.8	$ 47,689	$ 105,934	n/a
Waterville	Town	1,735	-3.2%	1,308	37.8	$ 46,692	$ 104,816	n/a
Sangerfield	Town	2,626	-1.4%	85	37.6	$ 47,563	$ 106,213	n/a
Madison	County	69,829	0.6%	106	36.1	$ 53,600	$ 109,000	39%
Oneida	County	232,304	-1.3%	192	38.2	$ 44,636	$ 102,300	40%
New York	State	19,297,729	1.7%	408	35.9	$ 53,514	$ 311,000	109%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

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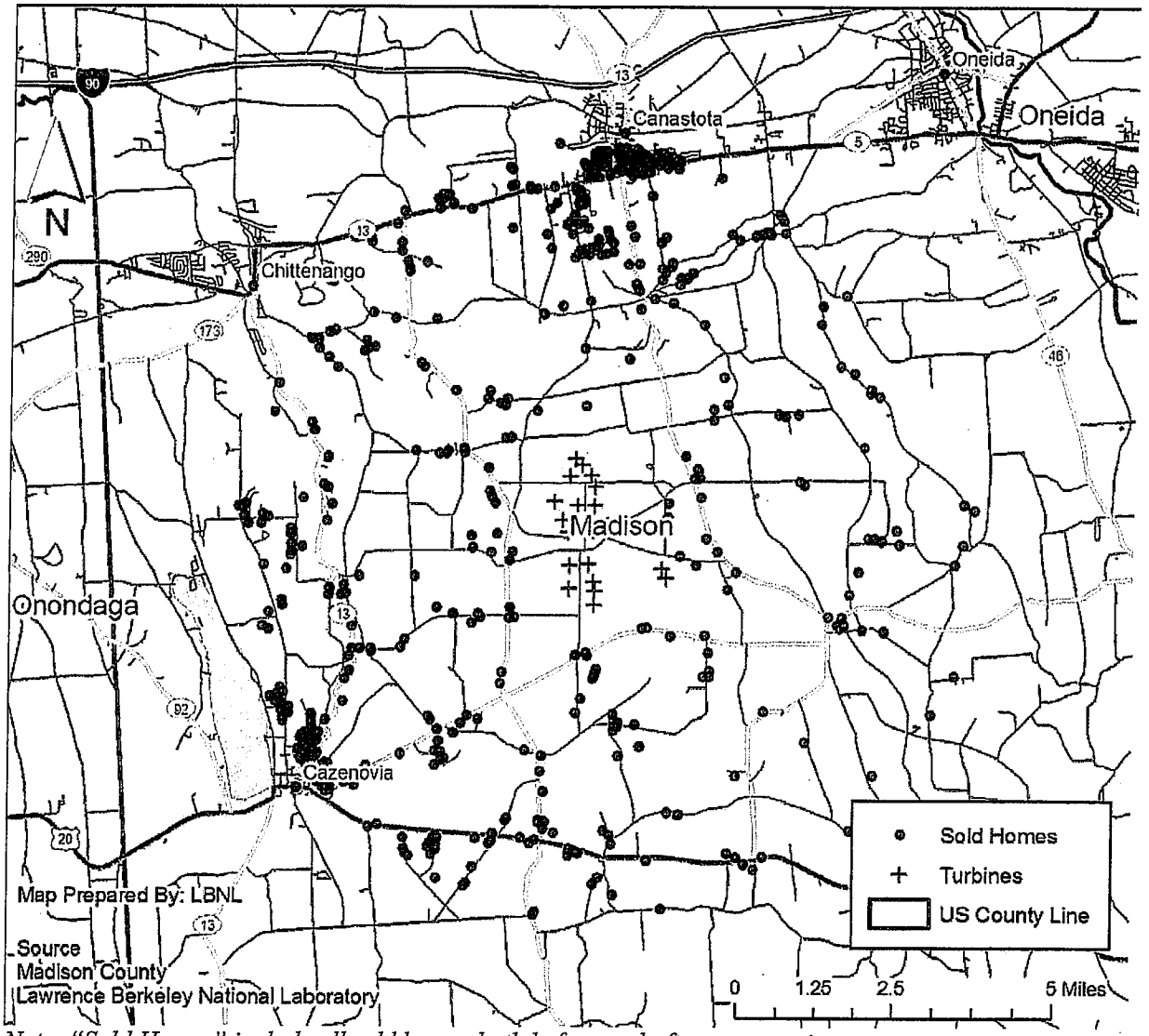
A.10 NYMC Study Area: Madison County (New York)

Figure A - 11: Map of NYMC Study Area



Note: "Sold Homes" include all sold homes both before and after construction.

Area Description

This study area surrounds the 20 turbine (30 MW, 218 ft hub height) Fenner wind facility in Madison County, New York, roughly 20 miles East of Syracuse and 40 miles West of Utica in the middle of New York. The study area is dominated by two roughly parallel ridges. One, on which the Fenner facility is located, runs Southeast to Northwest and falls away towards the town of Canastota. The second ridge runs roughly North from Cazenovia, and falls away just South of the town of Chittenango. Surrounding these ridges is an undulating landscape with many water features, including the Chittenango Falls and Lake Cazenovia. A number of high-priced homes are situated along the ridge to the North of Cazenovia, some of which are afforded

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views of the lake and areas to the West, others with views to the East over the wind facility, and a few having significant panoramic views. The west side of the study area has a number of drivers to its real estate economy: it serves as a bedroom community for Syracuse, is the home to Cazenovia College, and enjoys a thriving summer recreational population. Canastota to the North, and Oneida to the East, are older industrial towns, both of which now serve as feeder communities for Syracuse because of easy access to Highway 90. Between the towns of Cazenovia and Canastota are many rural residential properties, some of which have been recently developed, but most of which are homes at least a half century old.

Data Collection and Summary

Data were obtained from the Madison County Real Property Tax Services department directed by Carol Brophy. As the first study area that was investigated, IT and mapping specialists Kevin Orr and Mike Ellis were subjected to a large number of questions from the study team and were enormously helpful in helping shape what became the blueprint for other study areas. Additionally, real estate brokers Nancy Proctor of Prudential, Joel Arsenault of Century 21, Don Kinsley of Kingsley Real Estate, and Steve Harris of Cazenovia Real Estate were extremely helpful in understanding the local market.

Data on 693 valid sales transactions of single family residential structures that occurred between 1996 and 2006 were obtained, most of which were within five miles of the wind facility. These sales ranged in price from $26,000 to $575,000, with a mean of $124,575. Roughly 68% of these sales ($n = 469$) occurred after construction commenced on the wind facility, 13 of which were inside of one mile, and 74 of which had views of the turbines. Of that latter group, 24 have more dramatic than MINOR views of the turbines.

Area Statistics

Study Period Begin	Study Period End	Number of Sales	Median Price	Mean Price	Minimum Price	Maximum Price
1/31/1996	9/29/2006	693	$109,900	$124,575	$26,000	$575,000

Facility Statistics

Facility Name	Number of MW	Number of Turbines	Announce Date	Construction Begin Date	Completion Date	Turbine Maker	Hub Height (Meters)
Fenner Wind Power Project	30	20	Dec-98	Mar-01	Nov-01	Enron	66

Source: AWEA & Ventyx Inc.

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Variables of Interest Statistics

Development Period	Pre Announcement	Post Announcement Pre Construction	1st Year After Construction	2nd Year After Construction	2+ Years After Construction	Total
Madison, NY (NYMC)	59	165	74	70	325	693

View of Turbines	Pre Construction	None	Minor	Moderate	Substantial	Extreme	Total
Madison, NY (NYMC)	224	395	50	16	8	0	693

Distance to Nearest Turbine	Pre Construction	< 0.57 Miles	0.57 - 1 Miles	1 - 3 Miles	3 - 5 Miles	> 5 Miles	Total
Madison, NY (NYMC)	224	2	11	80	374	2	693

Census Statistics

Name	Type	2007 Population	% Change Since 2000	Population Per Mile^2	Median Age	Median Income	Median House 2007	% Change Since 2000
Cazenovia	Town	2,835	8.6%	1,801	32.3	$ 58,172	$ 159,553	n/a
Chittenango	Town	4,883	-0.5%	2,000	36.0	$ 58,358	$ 104,845	n/a
Canastota	Town	4,339	-1.7%	1,306	37.3	$ 45,559	$ 93,349	n/a
Oneida	City	10,791	-1.7%	490	36.9	$ 47,173	$ 99,305	n/a
Morrisville	Town	2,155	0.6%	1,869	20.4	$ 45,852	$ 102,352	n/a
Madison	County	69,829	0.6%	106	36.1	$ 53,600	$ 109,000	39%
New York	State	19,297,729	1.7%	408	35.9	$ 53,514	$ 311,000	109%
US	Country	301,139,947	6.8%	86	37.9	$ 50,233	$ 243,742	46%

Source: City-Data.com & Wikipedia. "% Change Since 2000" refers to the percentage change between 2000 and 2007 for the figures in the column to the left (population or median house price). "Town" signifies any municipality with less than 10,000 inhabitants. "n/a" signifies data not available.

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Appendix B: Methodology for Calculating Distances with GIS

For each of the homes in the dataset, accurate measurements of the distance to the nearest wind turbine at the time of sale were needed, and therefore the exact locations of both the turbines and the homes was required. Neither of these locations was available from a single source, but through a combination of techniques, turbine and home locations were derived. This section describes the data and techniques used to establish accurate turbine and home locations, and the process for then calculating distances between the two.

There were a number of possible starting points for mapping accurate wind turbine locations. First, the Energy Velocity data, which covered all study areas, provided a point estimate for project location, but did not provide individual turbine locations. The Federal Aviation Administration (FAA), because of permitting and aviation maps, maintains data on turbine locations, but at the time of this study, that data source did not cover all locations, contained data on structures that no longer exist, and was difficult to use.[110] Finally, in some cases, the counties had mapped the wind turbines into GIS.

In the end, because no single dataset was readily available to serve all study areas, instead the variety of data sources described above was used to map and/or confirm the location of every turbine in the 10 study areas. The process began with high-resolution geocoded satellite and aerial ortho imagery that the United States Department of Agriculture (USDA) collects and maintains under its National Agriculture Imagery Program (NAIP), and which covers virtually all of the areas in this investigation. Where needed, older ortho imagery from the USDA was used. Combining these data with the Energy Velocity data, and discussions with local officials, and maps provided by the county or the developer, locating and mapping all of the turbines in each study area was possible.

Home locations were provided directly by some counties; in other cases, a parcel centroid was created as a proxy. [111] In some situations, the centroid did not correspond to the actual house location, and therefore required further refinement. This refinement was only required and conducted if the parcel was near the wind turbines, where the difference of a few hundred feet, for example, could alter its distance rating in a meaningful fashion, or when the parcel included a considerable amount of acreage, where inaccuracy in home location could be considerable. Therefore, parcels inside of 1.5 miles of the nearest wind turbine and of any size, and parcels outside of 1.5 miles and larger than 5 acres, were both examined using the USDA NAIP imagery to determine the exact home location. In cases where the parcel centroid was not centered over the home, the location was adjusted, using the ortho image as a guide, to the actual house location.

With both turbine and home locations identified, the next step was to determine distances between the two. To do so, the date when each transaction in the sample occurred was taken into

[110] A newer FAA database is now available that clears up many of these earlier concerns.

[111] A "parcel centroid" is the mathematical center point of a polygon, and was determined by XTools Pro (www.xtoolspro.com).

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account, combined with the determination of which turbines were in existence at what time.[112] This required breaking the transactions in the sample into three categories: 1) those occurring before any wind facility was announced in the study area, 2) those occurring after the first wind facility was announced in the area but before all development was complete in the area, and 3) those occurring after all wind development in the area was complete. Any sale that occurred before wind development was announced in the study area was coded with a distance to the nearest turbine derived from the actual turbine locations after all wind development had occurred.[113] Homes that sold after all wind development had occurred were treated similarly, with distances derived from the set of turbines in place after all development had taken place. The final set of homes - those that sold after announcement of the first facility, but before the construction of the last - had to be treated, essentially, on a case by case basis. Some homes were located within five miles of one wind facility but more than five miles from another wind facility in the same study area (e.g., many homes in PASC). In this case the distance to that closer facility could be applied in a similar fashion as would be the case if only one facility was erected (e.g., NYMC or PAWC). Another group of homes, those that sold during the development of the first facility in the study area, were given the distance to that facility, regardless of distance to the other facilities in the study area. The final and most complicated group of homes consisted of those that were within five miles of multiple wind facilities, and that sold after the first facility had been erected. In those cases, the exact configuration of turbines was determined for each stage of the development process. In study areas with multiple facilities that were developed over multiple periods, there might be as many as six possible configurations (e.g., IABV). In this final scenario, the distance to the closest turbine was used, assuming it had been "announced" at the time of sale.

Once the above process was complete, the mechanics of calculating distances from the turbines to the homes was straightforward. After establishing the location of a set of turbines, for instance those constructed in the first development in the area, a euclidian distance raster was derived that encompassed every home in the study area.[114] The calculations were made using a 50-foot resolution state-plane projection and North American Datum from 1983 (NAD83). As discussed above, similar rasters were created for each period in the development cycle for each study area, depending on the turbine configuration at that time. Ultimately, a home's sale date was matched to the appropriate raster, and the underlying distance was extracted. Taking everything into account discussed above, it is expected that these measurements are accurate to

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[112] It is recognized that the formal date of sale will follow the date at which pricing decisions were made. It is also recognized, as mentioned in Section 3, that wind facility announcement and construction dates are likely to be preceded by "under the radar" discussions in the community. Taken together, these two factors might have the effect, in the model, of creating some apparent lag in when effects are shown, compared to the earlier period in which effects may begin to occur. For this to bias the results, however, effects would have to disappear or dramatically lesson with time (e.g., less than one year after construction) such that the effects would not be uncovered with the models in later periods. Based on evidence from other potentially analogous infrastructure (e.g., HVTL), any fading of effects would likely occur over many years, so it is assumed that any bias is likely minimal.

[113] These distances were used to compare homes sold, for instance, within 1 mile of where the turbines were eventually erected with similar homes sold after the turbines were erected (see, for example, the Temporal Aspects Model).

[114] A "Raster" is a grid of, in this case, 50 feet by 50 feet squares, each of which contains a number representing the number of feet from the center of the square to the nearest turbine.

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within roughly 150 feet inside of 1.5 miles and within a maximum of roughly 1150 feet outside of 1.5 miles.[115]

[115] The resolution of the raster is 50 feet, so the hypotenuse is 70 feet. If the home is situated in the top left of a raster cell and the turbine is situated in the bottom right of a diagonally adjacent cell, they could be separated by as much as 140 feet, yet the raster distance would only be 50 feet, a difference of 90 feet. Moreover, the resolution of the Ortho image is 40 feet so that location could additionally be off by another 55 feet along the diagonal. These two uncertainties total to roughly 150 feet for homes inside of 1.5 miles. Outside of 1.5 miles the variation between centroid and house location for parcels smaller than 5 acres could be larger still. If a 4.9 acre parcel had a highly irregular rectangular shape of 102 by 2100 feet, for instance, the centroid could be as much as 1050 feet from the property line. If the home was situated 50 feet from the property line then the actual house location could be off by as much as 1000 feet. Adding this to the 150 feet from above leads to a total discrepancy of 1150 feet (0.22 miles) for homes outside of 1.5 miles on parcels smaller than 5 acres. Of course, these extreme scenarios are highly unlikely to be prevalent.

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Appendix C: Field Data Collection Instrument

Figure A - 12: Field Data Collection Instrument

House # (Control/ Key #)			County		
House Address					
Home Characteristics			**House Photo Number(s)**		
Cul-De-Sac?	No(0) / Yes(1)		Waterfront?		No(0) / Yes(1)
Scenic Vista Characteristics			**Vista Photo Numbers**		
Overall Quality of Scenic Vista: Poor (1), Below Average (2), Average (3), Above Average (4), Premium (5)					
View of Turbines Characteristics			**View Photo Numbers**		
Total # of Turbines visible			Orientation of Home to View: See Below		
# of Turbines- blade tips only visible			Side (S), Front (F), Back (B), Angled (A)		
# of Turbines- nacelle/hub visible					
# of Turbines- tower visible			View Scope: Narrow(1), Medium(2), Wide(3)		
The Degree to which the View of Turbines Dominate the Site? Non-Existent (0), Minor (1), Moderate (2), Substantial (3), Extreme (4)					
Degree to which the Turbines Overlap the Prominent Scenic Vista? Not at all (0), Barely (1), Somewhat (2), Strongly (3), Entirely (4)					
Notes:					

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Figure A - 13: Field Data Collection Instrument - Instructions - Page 1

Home Characteristics

Cul-De-Sac? No(0)/Yes(1)	Is the home situated on a cul-de-sac?
Waterfront? No(0)/Yes(1)	Is the home situated on the waterfront?

"Vista" Characteristics

Overall Quality of Scenic Vista: Poor (1)	This rating is reserved for vistas of unmistakably poor quality. These vistas are often dominated by visually discordant man-made alterations (not considering turbines), or are uncomfortable spaces for people, lack interest, or have virtually no recreational potential.
Overall Quality of Scenic Vista: Below Average (2)	The home's vista is of the below average quality. These vistas contain visually discordant man-made alterations (not considering turbines) but are not dominated by them. They are not inviting spaces for people, but are not uncomfortable. They have little interest, mystery and have minor recreational potential.
Overall Quality of Scenic Vista: Average (3)	The home's vista is of the average quality. These vistas include interesting views which can be enjoyed often only a narrow scope. These vistas may contain some visually discordant man-made alterations (not considering turbines), are moderately comfortable spaces for people, have some interest, and have minor recreational potential.
Overall Quality of Scenic Vista: Above Average (4)	The vista from the home is of above average quality. These vistas include interesting views which often can be enjoyed in a medium to wide scope. They might contain some man made alterations (not considering turbines), yet still possess significant interest and mystery, are moderately balanced and have some potential for recreation.
Overall Quality of Scenic Vista: Premium (5)	This rating is reserved for vistas of unmistakably premium quality. These vistas would include "picture post card" views which can be enjoyed in a wide scope. They are often free or largely free of any discordant man made alterations (not considering turbines), possess significant interest, memorable qualities, mystery and are well balanced and likely have a high potential for recreation.
Degree Turbines Overlap Prominent Vista? Not at all (0))	The vista does not contain any view of the turbines.
Degree Turbines Overlap Prominent Vista? Barely (1)	A small portion (~ 0 - 20%) of the vista is overlapped by the view of turbines therefore the vista might contain a view of a few turbines, only a few of which can be seen entirely (from below the sweep of the blades to the top of their tips).
Degree Turbines Overlap Prominent Vista? Somewhat (2)	A moderate portion (~20-50%) of the vista contains turbines, and likely contains a view of more than one turbine, some of which are likely to be seen entirely (from below the sweep of the blades to the top of their tips).
Degree Turbines Overlap Prominent Vista? Strongly (3)	A large portion (~50-80%) of the vista contains a view of turbines, many of which likely can be seen entirely (from below the sweep of the blades to the top of their tips).
Degree Turbines Overlap Prominent Vista? Entirely (4)	This rating is reserved for situations where the turbines overlap virtually the entire (~80-100%) vista from the home. The vista likely contains a view of many turbines, virtually all of which can be seen entirely (from below the sweep of the blades to the top of their tips).

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Figure A - 14: Field Data Collection Instrument - Instructions - Page 2

View of Turbines Characterist

House Orientation to View of Turbines: Side (S)	Orientation of home to the view of the turbines is from the side.
House Orientation to View of Turbines: Front (F)	Orientation of home to the view of the turbines is from the front.
House Orientation to Vista of Turbines: Back (B)	Orientation of home to the view of the turbines is from the back.
House Orientation to Vista of Turbines: Angled (A)	Orientation of home to the view of the turbines is from an angle.
View of Turbines Scope: Narrow(1)	The view of the turbines is largely blocked by trees, large shrubs or man made features in the foreground (0-300 feet) allowing 0 - 30 degrees of view of the wind facility
View of Turbines Scope: Medium(2)	The view of turbines is partially blocked by trees, large shrubs or man made features in the foreground (0-300 feet) allowing only 30-90 degrees of view of the wind facility.
View of Turbines Scope: Wide(3)	The view of the turbines is free or almost free from blockages by trees, large shrubs or man made features in the foreground (0-300 feet) allowing at least 90 degrees of view of the wind facility.
Degree to which View of Turbines Dominates the Site? None (0)	The turbines are not visible at all from this home.
Degree to which View of Turbines Dominates the Site? Minor (1)	The turbines are visible but either the scope is narrow, there are many obstructions, or the distance between the home and the facility is large.
Degree to which View of Turbines Dominates the Site? Moderate (2)	The turbines are visible but the scope is either narrow or medium, there might be some obstructions, and the distance between the home and the facility is most likely a few miles.
Degree to which View of Turbines Dominates the Site? Substantial (3)	The turbines are dramatically visible from the home. The turbines are likely visible in a wide scope, and most likely the distance between the home and the facility is short.
Degree to which View of Turbines Dominates the Site? Extreme (4)	This rating is reserved for sites that are unmistakably dominated by the presence of the windfarm. The turbines are dramatically visible from the home and there is a looming quality to their placement. The turbines are often visible in a wide scope, or the distance to the facility is very small.

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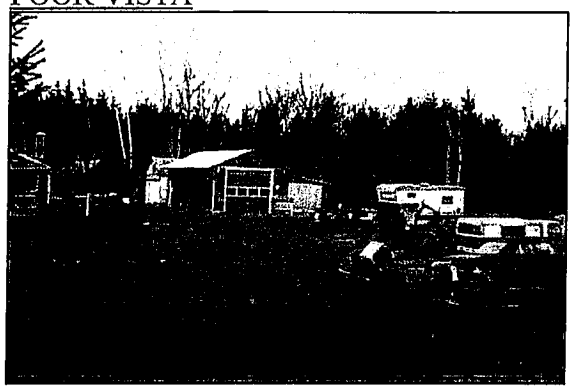
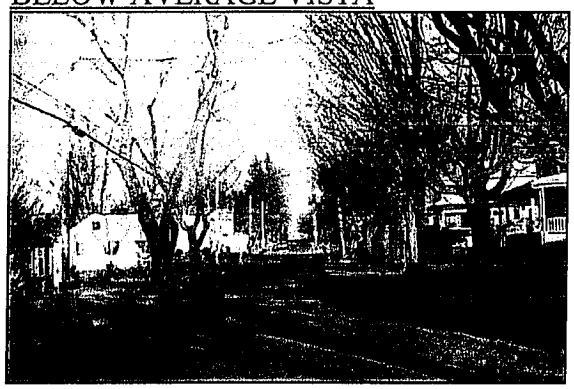
Appendix D: Vista Ratings with Photos

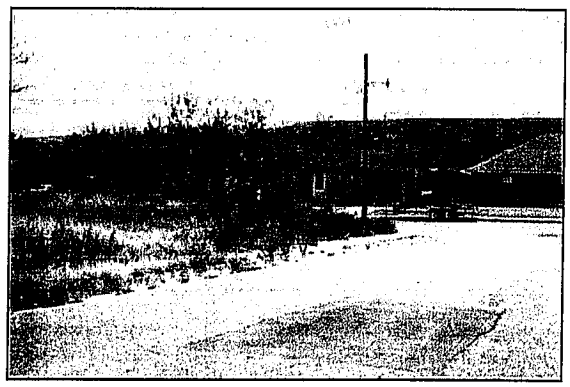
POOR VISTA





BELOW AVERAGE VISTA





AVERAGE VISTA





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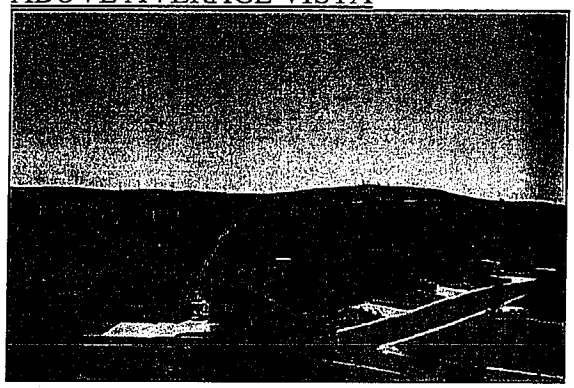
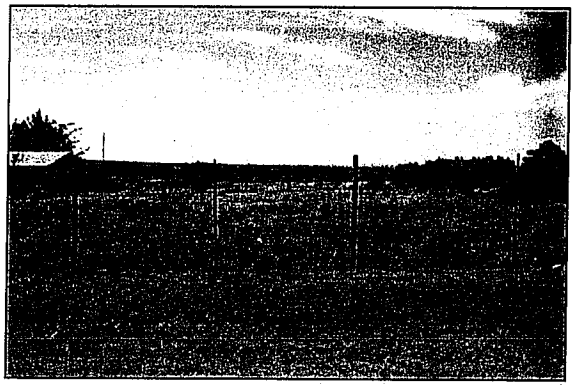
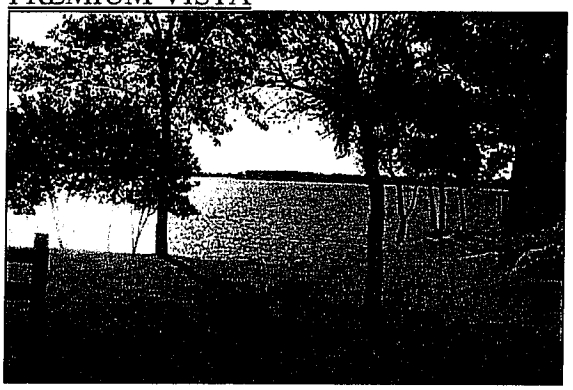
ABOVE AVERAGE VISTA





PREMIUM VISTA





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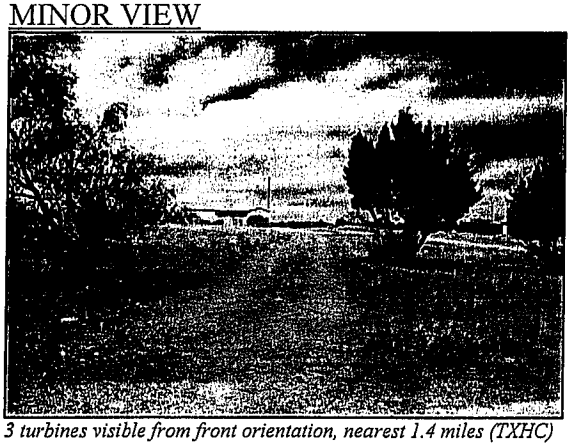
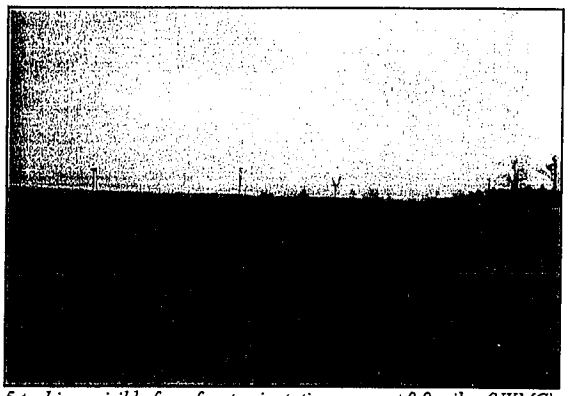
Appendix E: View Ratings with Photos

MINOR VIEW

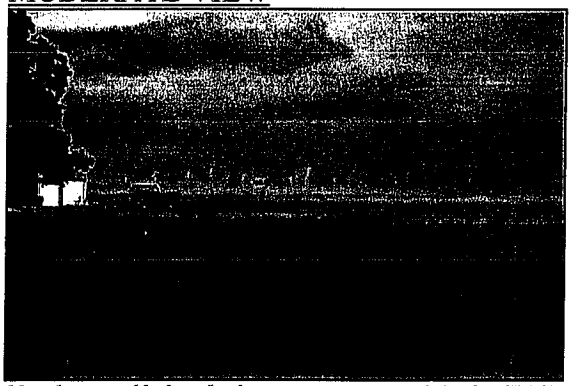


3 turbines visible from front orientation, nearest 1.4 miles (TXHC)

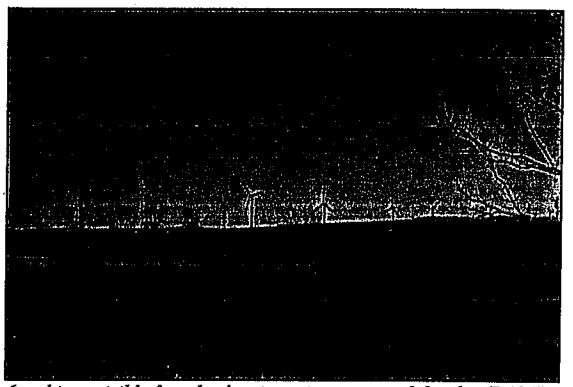


5 turbines visible from front orientation, nearest 0.9 miles (NYMC)

MODERATE VIEW

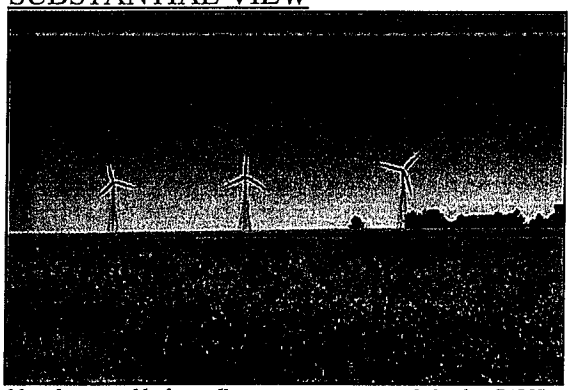


18 turbines visible from back orientation, nearest 1.6 miles (ILLC)

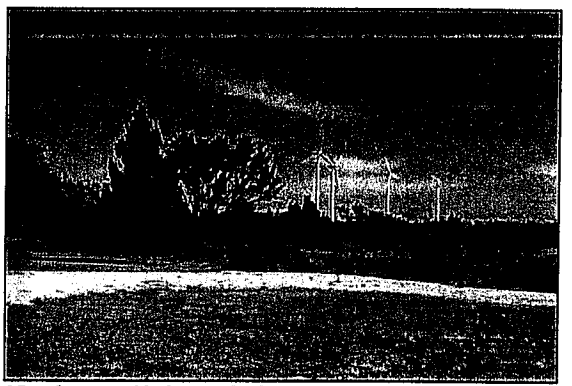


6 turbines visible from back orientation, nearest 0.8 miles (PASC)

SUBSTANTIAL VIEW



90 turbines visible from all orientations, nearest 0.6 miles (IABV)



27 turbines visible from multiple orientations, nearest 0.6 miles (TXHC)

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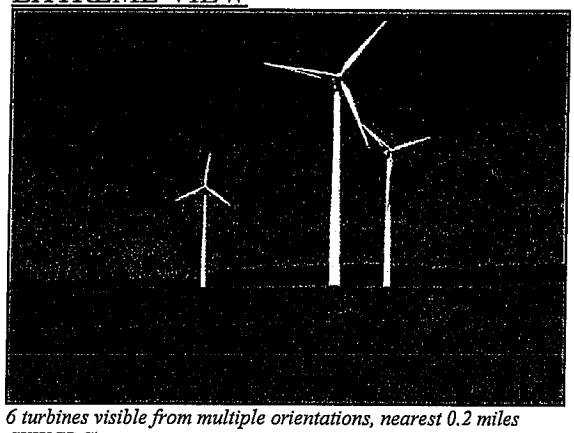
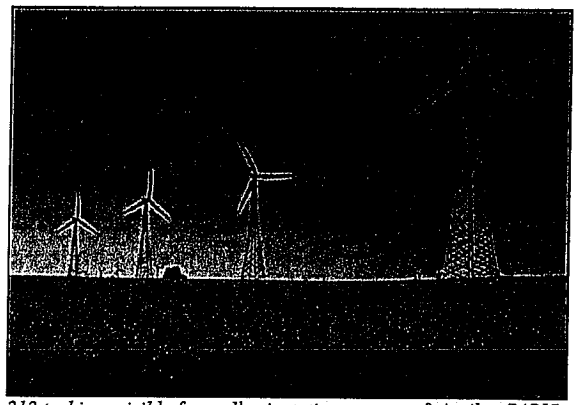
EXTREME VIEW



6 turbines visible from multiple orientations, nearest 0.2 miles (WIKCDC)



212 turbines visible from all orientations, nearest 0.4 miles (IABV)

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Appendix F: Selecting the Primary ("Base") Hedonic Model

Equation (1) as described in Section 4.2 is presented in this report as the primary (or "Base") model to which all other models are compared. As noted earlier, in the Base Hedonic Model and in all subsequent models presented in Section 5 all variables of interest, spatial adjustments, and home and site characteristics are pooled, and therefore their estimates represent the average across all study areas. Ideally, one would have enough data to estimate a model at the study area level - a fully unrestricted model - rather than pooled across all areas. In this appendix, alternative model forms are presented that unrestrict these variables at the level of study areas. As shown here, these investigations ultimately encouraged the selection of the somewhat simpler pooled Base Model as the primary model, and to continue to use restricted or pooled models in the alternative hedonic analyses.

F.1 Discussion of Fully Unrestricted Model Form

The Base Model described by equation (1) has variables that are pooled, and the coefficients for these variables therefore represent the average across all study areas (after accounting for study area fixed effects). An alternative (and arguably superior) approach would be to estimate coefficients at the level of each study area, thereby allowing coefficient values to vary among study areas.[116] This fully interacted – or unrestricted – model would take the following form:

$$\ln(P) = \beta_0 + \sum_s \beta_1 (N \cdot S) + \sum_c \beta_2 (Y) + \sum_k \beta_3 (X \cdot S) + \sum_v \beta_4 (VIEW \cdot S) + \sum_d \beta_5 (DISTANCE \cdot S) + \varepsilon \quad \text{(F13)}$$

where

P represents the inflation-adjusted sale price,
N is the spatially weighted neighbors' predicted sale price,
S is a vector of *s* study areas (e.g., WAOR, OKCC, etc.),
Y is a vector of *c* study area locational characteristics (e.g., census tract, school district, etc.),
X is a vector of k home and site characteristics (e.g., acres, square feet, number of bathrooms, condition of the home, age of home, VISTA, etc.),
VIEW is a vector of v categorical view of turbine variables (e.g., MINOR, MODERATE, etc.),
DISTANCE is a vector of d categorical distance to turbine variables (e.g., less than 3000 feet, between one and three miles, etc.),
β_0 is the constant or intercept across the full sample,
β_1 is a vector of *s* parameter estimates for the spatially weighted neighbor's predicted sale price for S study areas,
β_2 is a vector of *c* parameter estimates for the study area locational fixed effect variables,
β_3 is a vector of *k* parameter estimates for the home and site characteristics for S study areas,
β_4 is a vector of *v* parameter estimates for the VIEW variables as compared to homes sold with no view of the turbines for S study areas,

[116] For instance, the marginal contribution of Acres (the number of acres) to the selling price would be estimated for each study area (i.e., Acres_WAOR, Acres_TXHC etc.), as would the variables of interest: VIEW and DISTANCE.

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β_5 is a vector of d parameter estimates for the DISTANCE variables as compared to homes sold situated outside of five miles for S study areas, and
ε is a random disturbance term.

To refresh, the fully restricted equation (1) takes the following form:

$$\ln(P) = \beta_0 + \beta_1 N + \sum_s \beta_2 S + \sum_k \beta_3 X + \sum_v \beta_4 VIEW + \sum_d \beta_5 DISTANCE + \varepsilon \quad (1)$$

where
P represents the inflation-adjusted sale price,
N is the spatially weighted neighbors' predicted sale price,
S is the vector of s Study Area fixed effects variables (e.g., WAOR, OKCC, etc.),
X is a vector of k home and site characteristics (e.g., acres, square feet, number of bathrooms, condition of the home, age of home, VISTA, etc.),
VIEW is a vector of v categorical view of turbine variables (e.g., MINOR, MODERATE, etc.),
DISTANCE is a vector of d categorical distance to turbine variables (e.g., less than 3000 feet, between one and three miles, etc.),
β_0 is the constant or intercept across the full sample,
β_1 is a parameter estimate for the spatially weighted neighbor's predicted sale price,
β_2 is a vector of s parameter estimates for the study area fixed effects as compared to homes sold in the Washington/Oregon (WAOR) study area,
β_3 is a vector of k parameter estimates for the home and site characteristics,
β_4 is a vector of v parameter estimates for the VIEW variables as compared to homes sold with no view of the turbines,
β_5 is a vector of d parameter estimates for the DISTANCE variables as compared to homes sold situated outside of five miles, and
ε is a random disturbance term.

The significant change between equations (1) and (F13) is that each of the primary groups of variables in equation (F13) is interacted with the study areas (S) so that parameters can be estimated at the study area level. For example, whereas ACRES is estimated in equation (1) across all study areas, in equation (F13) it is estimated for each study area (i.e., Acres_WAOR, Acres_TXHC, etc).[117] Similarly, when considering the possible impact of wind facilities on residential sales prices, equation (1) seeks average effects that exist over the entire sample, while equation (F13) instead looks for differential effects in each individual study area. Additionally, in equation (F13), instead of estimating fixed effects using inter-study area parameters alone (e.g., WAOR, TXHC), a set of intra-study area effects (Y) - school district and census tract delineations - are added.[118] These latter coefficients represent not only effects that are presumed

[117] This change is made because, theoretically, the contribution to sales prices of home or site characteristics may differ between study areas – for instance Central_AC in Texas vs. New York – and therefore estimating them at the study area level may increase the explanatory power of the model.

[118] In the evaluation and selection of the best model to use as the "Base Model" a set of census tract and school district delineations were used instead of the study area fixed effects. These more-granular fixed effects were extracted from GIS using house locations and census tract and school district polygons. Often, the school district and census tract delineations were not mutually exclusive. For example, in Wisconsin the WIKCDC study area contains four school districts and six census tracts, none of which completely overlap. Alternatively, in some study

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to exist over each entire study area (inter-study area effects), but also intra-study area effects such as differences in home valuation due to school districts, distances to amenities, and other locationally bound influences. As with the inter-study area coefficients, because of the myriad influences captured by these variables, interpretation of any single coefficient can be difficult. However, it is expected that such coefficients would be influential, indicating significant differences in value between homes in each study area and across study areas due to school district quality and factors that differ between census tracts (e.g., crime rates).

Although the fully unrestricted model described by equation (F13) is arguably superior to the fully restricted model described in equation (1) because of its ability to resolve differences between and within study areas that are not captured by the Base Model, there are three potential drawbacks:

- Model parsimony and performance;
- Standard error magnitudes; and
- Parameter estimate stability.

Each of these potential drawbacks is discussed in turn below:

Model parsimony and performance: In general, econometricians prefer a simpler, more parsimonious statistical model. In this instance, variables should be added to a model only if their addition is strongly supported by theory and if the performance of the model is substantially improved by their inclusion. As such, if a model with a relatively small number of parameters performs well, it should be preferred to a model with more parameters unless the simple model can be "proven to be inadequate" (Newman, 1956). To prove the inadequacy of a simpler model requires a significant increase in performance to be exhibited from the more complex model. In this case, as presented later, performance is measured using the combination of Adjusted R^2, Modified R^2, and the Schwarz information criterion (see footnote 119 on page 127).

Standard error magnitudes: The magnitude of the standard errors for the variables of interest, as well as the other controlling variables, are likely to increase in the unrestricted model form because the number of cases for each variable will decrease when they are estimated at the study area level. Within each study area, there are a limited number of home transactions that meet the criteria for inclusion in the model, but even more limiting is the number of home transactions within each study area that have the characteristics of interest. For example, in Lee County, IL (ILLC), there are 205 post-construction home sales, while in Wayne County, PA (PAWC) there are 222. More importantly, in those areas, the data include a total of one and eleven sales inside of one mile, respectively, and a total of one and two homes with either EXTREME or SUBSTANTIAL rated views of turbines. With so few observations, there is increased likelihood that a single or small group of observations will strongly influence the sample mean of an independent variable. Since the standard error is derived from the variance of the parameter estimate, which in turn is derived from the summed deviation of each observation's actual level relative to its sample mean, this standard error is more likely to be larger than if a larger sample were considered. If the presence of wind facilities does have a detrimental effect on property

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areas the school district and census tracts perfectly overlapped, and in those cases either both were omitted as the reference category or one was included and the other withdrawn from the model to prevent perfect collinearity.

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values, that effect seems likely to be relatively small, at least outside of the immediate vicinity of the wind turbines. The smaller sample sizes for the independent variables that come with the unrestricted model, which may decrease statistical precision by producing larger standard errors, would likely decrease the ability to accurately identify these possible effects statistically. To explore the magnitude of this concern, the difference in standard errors of the variables of interest is investigated among the restricted and unrestricted models.

Parameter estimate stability: In an unrestricted model, parameter estimates are more likely to be unstable because the sample of home transactions with any particular characteristic may be small and thus not representative of the population as a whole. As mentioned above, there are a limited number of transactions within each study area that have the characteristics of interest. Restricting the sample size by using an unrestricted model increases the likelihood that a limited number of observations, which in the population as a whole represent a very small segment, will drive the results in one direction or another, thereby leading to erroneous conclusions. The difference in parameter estimates is investigated by comparing the coefficients for the unrestricted variables of interest to those for the restricted variables of interest. Additionally, the sign of any significant variables will be investigated for the unrestricted models, which might help uncover potentially spurious results.

F.2 Analysis of Alterative Model Forms

Here the spectrum of alternative models is explored, from the fully restricted equation (1) to the fully unrestricted equation (F13). To do so, not only are these two ends of the spectrum estimated, but also 14 intermediate models are estimated that consist of every combination of restriction of the four variable groups (i.e., variables of interest, spatial adjustments, study area delineations, and home and site characteristics). This produces a total of 16 models over which to assess model parsimony and performance, standard error size, and coefficient stability. This process allows for an understanding of model performance but, more importantly, to ultimately define a "Base Model" that is parsimonious (i.e., has the fewest parameters), robust (i.e., high adjusted R^2), and best fits the purpose of investigating wind facility impacts on home sales prices.

Table A - 2 presents the performance statistics for each of the 16 models defined above, moving from the fully restricted model equation (1) ("Model 1") to the fully unrestricted model equation (F13) ("Model 16"). In columns 2 – 5 of the table, the "R" represents a restriction for this variable group (i.e., not crossed with the study areas) and the "U" represents the case when the variable group is unrestricted (i.e., crossed with the study areas). Also shown are summary model statistics (i.e., Adjusted R^2, Modified R^2, and Schwarz information criterion - "SIC"), as well as the number of estimated parameters (k). [119] All models were run using the post-construction data subset of the sample of home sales transactions (n = 4,937).

[119] Goldberger (1991), as cited by Gujarati (2003), suggests using a Modified $R^2 = (1 - k/n) * R^2$ to adjust for added parameters. For example, Models 1 and 14 have Modified R^2 of 0.76, yet Adjusted R^2 of 0.77 and 0.78 respectively. Therefore the Modified R^2 penalizes their measure of explanatory power more than the Adjusted R^2 when taking into account the degrees of freedom. Similarly, the Schwarz information criterion penalizes the models for increased numbers of parameters (Schwarz, 1978). More importantly, practitioners often rely on the Schwarz criterion – over the Modified or Adjusted R^2 statistics - to rank models with the same dependent variable by their relative parsimony (Gujarati, 2003). Therefore it will be used for that purpose here.

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Model Parsimony and Performance

Overall, the fully restricted model (1) performs well with only 37 independent variables, producing an Adjusted R^2 of 0.77. Despite the limited number of explanatory variables, the model explains ~77% of the variation in home prices in the sample. When the fully unrestricted model 16 (equation F13) is estimated, which lies at the other end of the spectrum, it performs only slightly better, with an Adjusted R^2 of 0.81, but with an additional 285 explanatory variables. It is therefore not surprising that the Modified R^2 is 0.76 for Model 1 and is only 0.77 for Model 16. Similarly, the Schwarz information criterion (SIC) increases from 0.088 to 0.110 when moving from model 1 to model 16 indicating relatively less parsimony. Combined, these metrics show that the improvement in the explanatory power of model 16 over model 1 is not enough to overcome the lack of parsimony. Turning to the 14 models that lie between Models 1 and 16, in general, little improvement in performance is found over Model 1, and considerably less parsimony, providing little initial justification to pursue a more complex specification than equation (1).

Table A - 2: Summarized Results of Restricted and Unrestricted Model Forms

Model [1]	Study Area [2]	Spatial Adjustment	Home and Site Characteristics	Variables of Interest	Adj R^2	Modified R^2	SIC	*k* †
1	R	R	R	R	0.77	0.76	0.088	37
2	U	R	R	R	0.74	0.73	0.110	111
3	R	U	R	R	0.77	0.76	0.088	46
4	R	R	U	R	0.80	0.78	0.095	188
5	R	R	R	U	0.77	0.76	0.093	88
6	U	U	R	R	0.78	0.76	0.094	120
7	R	U	U	R	0.80	0.77	0.096	197
8	R	R	U	U	0.80	0.77	0.101	239
9	U	R	U	R	0.80	0.77	0.107	262
10	U	R	R	U	0.76	0.75	0.107	162
11	R	U	R	U	0.77	0.76	0.094	97
12	U	U	U	R	0.81	0.77	0.103	271
13	R	U	U	U	0.80	0.77	0.103	248
14	U	U	R	U	0.78	0.76	0.100	171
15	U	R	U	U	0.80	0.76	0.113	313
16	U	U	U	U	0.81	0.77	0.110	322

"R" indicates parameters are pooled ("restricted") across the study areas.

"U" indicates parameters are not pooled ("unrestricted"), and are instead estimated at the study area level.

1 - *Model numbers do not correspond to equation numbers listed in the report; equation (1) is Model 1, and equation (F1) is Model 16.*

2 - *In its restricted form "Study Area" includes only inter-study area delineations, while unrestricted "Study Area" includes intra-study area delineations of school district and census tract.*

† - *Numbers of parameters do not include intercept or omitted variables.*

The individual contributions to model performance from unrestricting each of the variable groups in turn (as shown in Models 2-5) further emphasizes the small performance gains that are earned despite the sizable increases in the number of parameters. As a single group, the

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unrestricted Home and Site Characteristics model (Model 4) makes the largest impact on model performance, at least with respect to the Adjusted R^2 (0.80), but this comes with the addition of 151 estimated parameters a slight improvement in the Modified R^2 (0.78) and a worsening SIC (0.095). Adding unrestricted Study Area delineations (Model 2), on the other hand, adversely affects performance (Adj. R^2 = 0.74, Modified R^2 = 0.73) and adds 74 estimated parameters (SIC = 0.110). Similarly, unrestricting the Spatial Adjustments (Model 3) offers little improvement in performance (Adj. R^2 = 0.77, Modified R^2 = 0.76) despite adding nine additional variables (SIC = 0.088). Finally, unrestricting the Variables of Interest (Model 5) does not increase model performance (Adj. R^2 = 0.77, Modified R^2 = 0.76) and adds 51 variables to the model (SIC = 0.093). This pattern of little model improvement yet considerable increases in the number of estimated parameters (i.e., less parsimony) continues when pairs or trios of variable groups are unrestricted. With an Adjusted R^2 of 0.77, the fully restricted equation (1) performs more than adequately, and is, by far, the most parsimonious.

Standard Error Magnitudes

Table A - 3 summarizes the standard errors for the variables of interest for all of the 16 models, grouped into restricted and unrestricted model categories. The table specifically compares the medians, minimums, and maximums of the standard errors for the models with restricted variables of interest (1, 2, 3, 4, 6, 7, 9 and 12) to those with unrestricted variables of interest (5, 8, 10, 11, 13, 14, 15 and 16).[120] The table demonstrates that the unrestricted standard errors for the variables of interest are significantly larger than the restricted standard errors. In fact, the minimum standard errors in the unrestricted models are often higher than the maximum standard errors produced in the restricted models. For example, the maximum standard error for an EXTREME VIEW in the restricted models is 0.09, yet the minimum in the unrestricted models is 0.12, with a maximum of 0.34. To put this result in a different light, a median standard error for the unrestricted EXTREME VIEW variable of 0.25 would require an effect on house prices larger than 50% to be considered statistically significant at the 90% level. Clearly, the statistical power of the unrestricted models is weak.[121] Based on other disamenities, as discussed in Section 2.1, an effect of this magnitude is very unlikely. Therefore, based on these standard errors, there is no apparent reason to unrestrict the variables of interest.

[120] For the restricted models, the medians, minimums, and maximums are derived across all eight models for each variable of interest. For the unrestricted models, they are derived across all study areas and all eight models for each variable of interest.

[121] At 90% confidence a standard error of 0.25 would produce a confidence interval of roughly +/- 0.42 (0.25 * 1.67). An effect of this magnitude represents a 52% change in sales prices because sales price is in a natural log form (e ^ 0.42-1 = 0.52).

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Table A - 3: Summary of VOI Standard Errors for Restricted and Unrestricted Models

Standard Errors	Restricted Models			Unrestricted Models		
	Standard Errors			Standard Errors		
	Median	Min	Max	Median	Min	Max
Minor View	0.01	0.01	0.02	0.05	0.03	0.07
Moderate View	0.03	0.03	0.03	0.10	0.06	0.18
Substantial View	0.05	0.05	0.06	0.19	0.10	0.29
Extreme View	0.08	0.08	0.09	0.25	0.12	0.34
Inside 3000 Feet	0.05	0.05	0.06	0.21	0.09	0.33
Between 3000 Feet and 1 Mile	0.04	0.04	0.05	0.13	0.08	0.40
Between 1 and 3 Miles	0.02	0.02	0.02	0.05	0.02	0.11
Between 3 and 5 Miles	0.01	0.01	0.02	0.05	0.02	0.10

Parameter Estimate Stability

Table A - 4 summarizes the coefficient estimates for the variables of interest for all of the 16 models. The table specifically compares the medians, minimums, and maximums of the coefficients for the models with restricted variables of interest (1, 2, 3, 4, 6, 7, 9 and 12) to those with unrestricted variables of interest (5, 8, 10, 11, 13, 14, 15 and 16). As shown, the coefficients in the unrestricted models diverge significantly from those in the restricted models. For example, in the restricted models, the median coefficient for homes inside of 3000 feet is -0.03, with a minimum of -0.06 and a maximum of -0.01, yet in the unrestricted models the median coefficient is 0.06, with a minimum of -0.38 and a maximum of 0.32. Similarly, a MODERATE VIEW in the restricted models has a median of 0.00, with a minimum of -0.01 and a maximum of 0.03, whereas the unrestricted models produce coefficients with a median of -0.05 and with a minimum of -0.25 and a maximum of 0.35.

Table A - 4: Summary of VOI Coefficients for Restricted and Unrestricted Models

Parameters	Restricted Models			Unrestricted Models		
	Coefficients			Coefficients		
	Median	Min	Max	Median	Min	Max
Minor View	-0.02	-0.03	0.00	-0.02	-0.16	0.24
Moderate View	0.00	-0.01	0.03	-0.05	-0.25	0.35
Substantial View	-0.01	-0.04	0.02	-0.08	-0.31	0.13
Extreme View	0.03	0.02	0.05	-0.03	-0.23	0.09
Inside 3000 Feet	-0.03	-0.06	-0.01	0.06	-0.38	0.32
Between 3000 Feet and 1 Mile	-0.04	-0.06	-0.01	-0.10	-0.44	0.52
Between 1 and 3 Miles	-0.01	-0.03	0.02	0.00	-0.23	0.40
Between 3 and 5 Miles	0.02	0.01	0.04	0.05	-0.05	0.32

Turning from the levels of the coefficients to the stability of their statistical significance and sign across models more reasons for concern are found. Table A - 5 summarizes the results of the unrestricted models, and presents the number of statistically significant variables of interest as a percent of the total estimated. The table also breaks these results down into two groups, those

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with coefficients above zero and those with coefficients below zero.[122] It should be emphasized here that it is the *a priori* expectation that, if effects exist, all of these coefficients would be less than zero, indicating an adverse effect on home prices from proximity to and views of wind turbines. Despite that expectation, when the variables of interest are unrestricted it is found that they are as likely to be above zero as they are below.[123] In effect, the small numbers of cases available for analysis at the study area level produce unstable results, likely because the estimates are being unduly influenced by either study area specific effects that are not captured by the model or by a limited number of observations that represents a larger fraction of the overall sample in that model.[124]

Table A - 5: Summary of Significant VOI Above and Below Zero in Unrestricted Models

Significant Variables	Unrestricted Models		
	Total	Below Zero	Above Zero
Minor View	32%	14%	18%
Moderate View	23%	11%	13%
Substantial View	4%	4%	0%
Extreme View	0%	0%	0%
Inside 3000 Feet	23%	15%	8%
Between 3000 Feet and 1 Mile	30%	14%	16%
Between 1 and 3 Miles	56%	32%	24%
Between 3 and 5 Miles	45%	3%	43%

F.3 Selecting a Base Model

To conclude, it was found that all three concerns related to the estimation and use of an unrestricted model form are borne out in practice. Despite experimenting with 16 different combinations of interactions, little overall improvement in performance is discovered. Where performance gains are found they are at the expense of parsimony as reflected in the lack of increase in the Modified R^2 and the relatively higher Schwartz information criterion. Further, divergent and spurious coefficients of interest and large standard errors are associated with those coefficients. Therefore the fully restricted model, equation (1), is used in this report as the "Base Model".

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[122] The "Total" percentage of significant coefficients is calculated by counting the total number of significant coefficients across all 8 unrestricted models for each variable of interest, and dividing this total by the total number of coefficients. Therefore, a study area that did not have any homes in a group (for example, homes with EXTREME VIEWS) was not counted in the "total number of coefficients" sum. Any differences between the sum of "above" and "below" zero groups from the total are due to rounding errors.

[123] The relatively larger number of significant variables for the MINOR rated view, MODERATE rated view, Mile 1 to 3, and Mile 3 to 5 parameters are likely related to the smaller standard errors for those categories, which result from larger numbers of cases.

[124] Another possible explanation for spurious results in general is measurement error, when parameters do not appropriately represent what one is testing for. In this case though, the VIEW variables have been adequately "ground truthed" during the development of the measurement scale, and are similar to the VISTA variables, which were found to be very stable across study areas. DISTANCE, or for that matter, distance to any disamenity, has been repeatedly found to be an appropriate proxy for the size of effects. As a result, it is not believed that measurement error is a likely explanation for the results presented here.

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Appendix G: OLS Assumptions, and Tests for the Base Model

A number of criteria must be met to ensure that the Base Model and Alternative Hedonic Models produce unbiased coefficient estimates and standard errors: 1) appropriate controls for outliers and influencers; 2) homoskedasticity; 3) absence of serial or spatial autocorrelation; and 4) reasonably limited multicollinearity. Each of these criteria, and how they are addressed, is discussed below.

Outliers and Influencers: Home sale prices that are well away from the mean, also called outliers and influencers, can cause undue influence on parameter estimates. A number of formal tests are available to identify these cases, the most common being Mahalanobis' Distance ("M Distance") (Mahalanobis, 1936) and standardized residual screening. M Distance measures the degree to which individual observations influence the mean of the residuals. If any single observation has a strong influence on the residuals, it should be inspected and potentially removed. An auxiliary, but more informal, test for identifying these potentially influential observations is to see when the standardized absolute value of the residual exceeds some threshold. Both the Base Model and the All Sales Model were run using the original dataset of 7,464 transactions and the 4,940 transactions which occurred post-construction respectively. For both models the standardized residuals and the M Distance statistics were saved.[125] The histograms of these two sets of statistics from the two regressions are shown in Figure A - 15 through Figure A - 18.

[125] For the M Distance statistics all variables of interest were removed from the model. If they were left in the M-Distance statistics could be influenced by the small numbers of cases in the variables of interest. If these parameters were strongly influenced by a certain case, it could drive the results upward. Inspecting the controlling variables in the model, and how well they predicted the sale prices of the transactions in the sample, was of paramount importance therefore the variables of interest were not included.

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Figure A - 15: Histogram of Standardized Residuals for Base Model

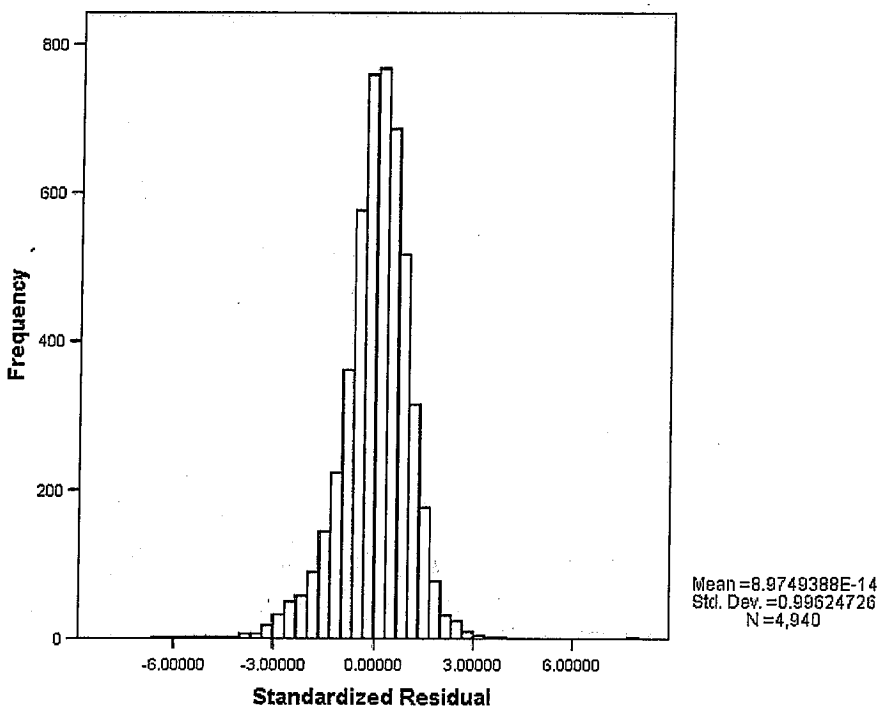

Figure A - 16: Histogram of Mahalanobis Distance Statistics for Base Model

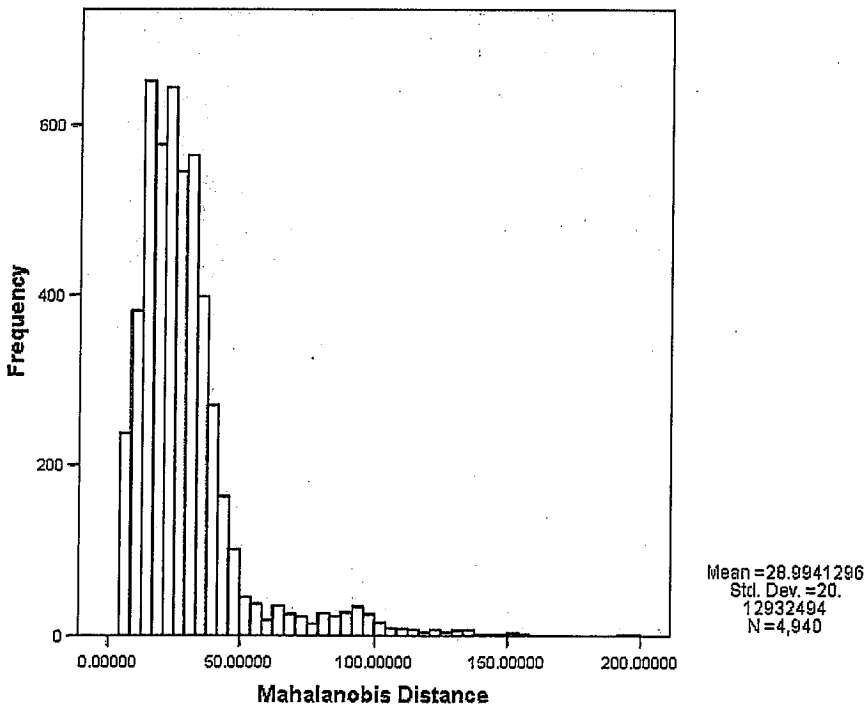

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Figure A - 17: Histogram of Standardized Residuals for All Sales Model

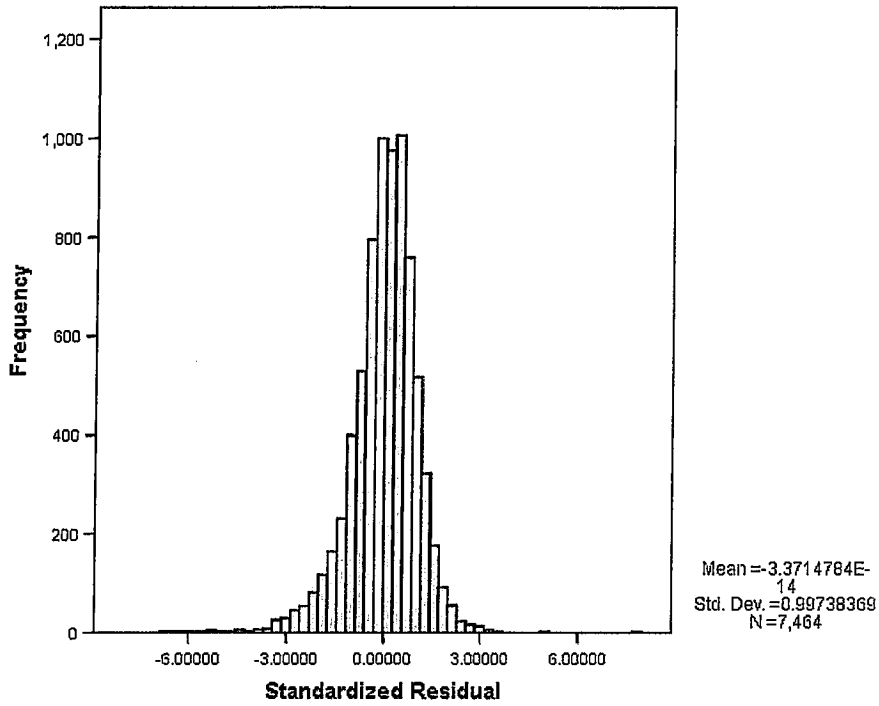
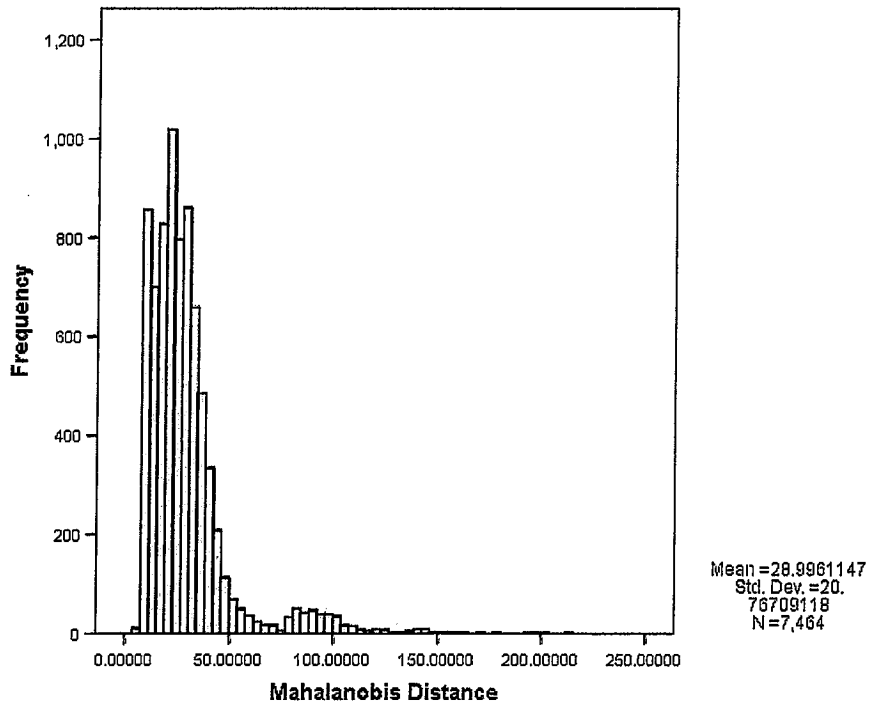


Figure A - 18: Histogram of Mahalanobis Distance Statistics for All Sales Model



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The M Distance histograms suggested that a cutoff of 150 may be appropriate, which would exclude 15 cases from the All Sales Model and seven cases from the Base Model (all of the latter of which were among the 15 outliers in the All Sales Model). The Standardized Residual histograms suggested a cutoff of 4, 5, or 6, which would exclude 13, 8, and 3 cases from the Base Model, and 22, 12, and 5 cases from the All Sales Model. A case-by-case investigation of each of these sales transactions was then conducted by comparing their home characteristics (e.g., square feet, baths, age, etc.) against their study area and panel model cohorts to ensure that none had been inappropriately coded. None of the M Distance flagged cases seemed to be inappropriately coded, and none of those cases were removed from the final dataset as a result. Five cases that were flagged from the All Sales Model (which corresponded to three cases in the Base Model) with a Standardized Residual greater than six, however, were clearly outliers. One had a sale price that was more than $200,000 more than any other transaction in the model, and the other four had exceptionally low prices, yet high numbers of corresponding characteristics that would suggest higher home sales prices (such as over 2000 square feet – all four cases – or more than two bathrooms – three cases).

As a result of these investigations, these five cases were removed from the model. One of the five cases occurred prior to announcement, one occurred after announcement and before construction, and the other three occurred after construction began. None were within three miles of the nearest wind turbine except one, which was 0.6 miles from the nearest turbine and had a MINOR view of the wind facility. The other two had no views of the turbines. Although there was hesitancy in removing any cases from the model, these transactions were considered appropriately influential and keeping them in the model would bias the results inappropriately. Further, the one home that was situated inside of one mile was surrounded by five other transactions in the same study area that also occurred after construction began and were a similar distance from the turbines, but that were not flagged by the outliers screen. Therefore, its removal was considered appropriate given that other homes in the sample would likely experience similar effects.

After removing these five cases, the sensitivity of the model results were tested to the inclusion or exclusion of the "greater than five" and "greater than four" Standardized Residuals observations and the cases flagged by the M Distance screen, finding that parameter estimates for the variables of interest moved slightly with these cases removed but not enough to change the results significantly. Because they did not show a unique grouping across the variables of interest, nor any unusual potentially inappropriate coding, and, more importantly, did not substantially influence the results, no substantive reason was found to remove any additional transactions from the sample. Therefore, the final dataset included a total of 7,459 cases, of which 4,937 occurred post-construction.

Homoskedasticity: A standard formal test for the presence of homoskedastic error terms is the White's statistic (White, 1980). However, the requirements to perform this test were overly burdensome for the computing power available. Instead, an informal test was applied, which plots the regression errors against predicted values and various independent variables to observe whether a "heteroskedastic pattern" is in evidence (Gujarati, 2003). Although no evidence of heteroskedasticity was found using this method, to be conservative, nonetheless all models were

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run with White's heteroskedasticity correction to the parameter estimates' standard errors (which will not adversely influence the errors if they are homoskedastic).

Serial Autocorrelation: A standard formal test for the presence of serial autocorrelation in the error term is the Durbin-Watson statistic (Durbin and Watson, 1951). Applying this test as proposed by Durbin and Watson to the full panel dataset was problematic because the test looks at the error structure based on the order that observations are included in the statistical regression model. Any ordering choice over the entire panel data set invariably involves mixing home transactions from various study areas. Ideally, one would segment the data by study area for purposes of calculating this test, but that method was not easily implemented with the statistical software package used for this analysis (i.e., SAS). Instead, study area specific regression models were run with the data chronologically ordered in each to produce twelve different Durbin-Watson statistics, one for each study area specific model. The Durbin-Watson test statistics ranged from 1.98–2.16, which are all within the acceptable range.[126] Given that serial autocorrelation was not found to be a significant concern for each study area specific model, it is assumed that the same holds for the full dataset used in the analysis presented in this report.

Spatial Autocorrelation: It is well known that the sales price of a home can be systematically influenced by the sales prices of those homes that have sold nearby (Dubin, 1998; LeSage, 1999). Both the seller and the buyer use information from comparable surrounding sales to inform them of the appropriate transaction price, and nearby homes often experience similar amenities and disamenities. Therefore, the price for any single home is likely to be weakly dependent of the prices of homes in close temporal and spatial proximity. This lack of independence of home sale prices could bias the hedonic results (Dubin, 1998; LeSage, 1999), if not adequately addressed. A number of techniques are available to address this concern (Case et al., 2004; Espey et al., 2007), but because of the large sample and computing limits, a variation of the Spatial Auto Regressive Model (SAR) was chosen (Espey et al., 2007).

Specifically, an independent variable is included in the models: the predicted values of the weighted nearest neighbor's natural log of sales price in 1996 dollars.[127] To construct this vector of predicted prices, an auxiliary regression is developed using the spatially weighted average natural log of sales price in 1996 dollars as the independent variable and the spatially weighted average set of home characteristics as the dependent variables. This regression was used to produce the predicted weighted nearest neighbor's natural log of sales price in 1996 dollars that is then included in the Base and Alternative Models. This process required the following steps:

1) Selecting the neighbors for inclusion in the calculation;
2) Calculating a weighted sales price from these neighbors' transactions;
3) Selecting and calculating the weighted neighbors home characteristics; and
4) Forecasting the weighted average neighbor's sales price.

- **Selecting the neighbors**: To select the neighbors whose home transactions would most likely have affected the sales price of the subject home under review, all of the homes that

[126] The critical values for the models were between 1.89 and 2.53, assuming 5% significance, greater than 20 variables, and more than 200 cases (Gujarati, 2003).

[127] The predicted value was used, instead of the actual value, to help correct for simultaneity or endogeneity problems that might otherwise exist.

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sold within the preceding six months of a subject home's sale date in the same study area are identified and, from those, the five nearest neighbors based on Euclidian distance are selected. The inverse of each selected nearest neighbors' distance (in quarter miles) to the subject home was then calculated. Each of these values was then divided by the sum of the five nearest neighbor's inverse distance values to create a neighbor's distance weight (NDW) for each of the five nearest neighbors.[128]

- **Creating the weighted sales price**: Each of the neighbor's natural log of sales price in 1996 dollars (LN_Saleprice96) is multiplied by its distance weight (NDW). Then, each weighted neighbor's LN_Saleprice96 is summed to create a weighted nearest neighbor LN_Saleprice96 (Nbr_LN_Saleprice96).

- **Selecting and calculating the weighted neighbors home characteristics**: Nine independent variables are used from each of the neighbor's homes: square feet, age of the home at the time of sale, age of the home at the time of sale squared, acres, number of full baths, and condition (1-5, with Poor = 1, Below Average = 2, etc.). A weighted average is created of each of the characteristics by multiplying each of the neighbor's individual characteristics by their NDW, and then summing those values across the five neighbors to create the weighted average nearest neighbors' home characteristic.[129] Then each of the independent variables is interacted with the study area to allow each one to be independently estimated for each study area.

- **Forecasting the weighted average neighbors sales price**: To create the final predicted neighbor's price, the weighted nearest neighbor LN_Saleprice96 is regressed on the weighted average nearest neighbors' home characteristics to produce a predicted weighted nearest neighbor LN_Saleprice96 (Nbr_LN_SalePrice96_hat). These predicted values are then included in the Base and Alternative Models as independent variables to account for the spatial and temporal influence of the neighbors' home transactions.

In all models, the coefficient for this spatial adjustment parameter meets the expectations for sign and magnitude and is significant well above the 99% level, indicating both the presence of spatial autocorrelation and the appropriateness of the control for it.

Multicollinearity: There are several standard formal tests for detecting multicollinearity within the independent variables of a regression model. The Variance-Inflation Factor and Condition Index is applied to test for this violation of OLS assumptions. Specifically, a Variance-Inflation Factor (VIF) greater than 4 and/or a Condition Index of greater than 30 (Kleinbaum et al., 1988) are strong indicators that multicollinearity may exist. Multicollinearity is found in the model using both tests. Such a result is not uncommon in hedonic models because a number of characteristics, such as square feet or age of a home, are often correlated with other characteristics, such as the number of acres, bathrooms, and fireplaces. Not surprisingly, age of the home at the time of sale (AgeofHome) and the age of the home squared (AgeatHome_Sqrd)

[128] Put differently, the weight is the contribution of that home's inverse distance to the total sum of the five nearest neighbors' inverse distances.

[129] Condition requires rounding to the nearest integer and then creating a dummy from the 1-5 integers.

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exhibited some multicollinearity (VIF equaled 11.8 and 10.6, respectively). Additionally, the home condition shows a fairly high Condition Index with square feet, indicating collinearity. More importantly, though, are the collinearity statistics for the variables of interest. The VIF for the VIEW variables range from 1.17 to 1.18 and for the DISTANCE variables they range from 1.2 to 3.6, indicating little collinearity with the other variables in the model. To test for this in another way, a number of models are compared with various identified highly collinear variables removed (e.g., AgeatSale, Sqft) and found that the removal of these variables had little influence on the variables of interest. Therefore, despite the presence of multicollinearity in the model, it is not believed that the variables of interest are inappropriately influenced. Further, any corrections for these issues might cause more harm to the model's estimating efficiency than taking no further action (Gujarati, 2003); as such, no specific adjustments to address the presence of multicollinearity are pursued further.

Appendix H: Alternative Models: Full Hedonic Regression Results

Table A - 6: Full Results for the Distance Stability Model

	Coef.	SE	p Value	*n*
Intercept	7.61	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.33	0.04	0.00	87
Cnd_Low	-0.45	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.13	0.01	0.00	1,445
Cnd_High	0.23	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.03	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.24	0.02	0.00	605
ILLC	-0.08	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.30	0.03	0.00	291
PAWC	-0.07	0.03	0.01	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
Mile_Less_0_57	-0.04	0.04	0.29	67
Mile_0_57to1	-0.06	0.05	0.27	58
Mile_1to3	-0.01	0.02	0.71	2,019
Mile_3to5	0.01	0.01	0.26	1,923
Mile_Gtr5	Omitted	Omitted	Omitted	870

"Omitted" = reference category for fixed effects variables

"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	2
Model Name	Distance Stability
Dependent Variable	LN_SalePrice96
Number of Cases	4937
Number of Predictors (k)	33
F Statistic	496.7
Adjusted R Squared	0.77

00003779

Table A - 7: Full Results for the View Stability Model

	Coef.	SE	Sig	*n*
Intercept	7.64	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.34	0.04	0.00	87
Cnd_Low	-0.45	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.13	0.01	0.00	1,445
Cnd_High	0.23	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.02	0.00	1,071
OKCC	-0.45	0.02	0.00	476
IABV	-0.25	0.02	0.00	605
ILLC	-0.09	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.08	0.03	0.00	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
Post_Con_NoView	Omitted	Omitted	Omitted	4,207
View_Minor	-0.02	0.01	0.25	561
View_Mod	0.00	0.03	0.90	106
View_Sub	-0.04	0.06	0.56	35
View_Extrm	-0.03	0.06	0.61	28

"Omitted" = reference category for fixed effects variables

"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	3
Model Name	View Stability
Dependent Variable	LN_SalePrice96
Number of Cases	4937
Number of Predictors (k)	33
F Statistic	495.9
Adjusted R Squared	0.77

00003780

Table A - 8: Full Results for the Continuous Distance Model

	Coef.	SE	p Value	*n*
Intercept	7.64	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.34	0.04	0.00	87
Cnd_Low	-0.45	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.13	0.01	0.00	1,445
Cnd_High	0.23	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.02	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.25	0.02	0.00	605
ILLC	-0.09	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.07	0.03	0.00	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
No View	Omitted	Omitted	Omitted	4,207
Minor View	-0.01	0.01	0.33	561
Moderate View	0.01	0.03	0.77	106
Substantial View	-0.02	0.07	0.72	35
Extreme View	0.01	0.10	0.88	28
InvDISTANCE	-0.01	0.02	0.46	4,937

"Omitted" = reference category for fixed effects variables

"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	5
Model Name	Continuous Distance Model
Dependent Variable	LN_SalePrice96
Number of Cases	4937
Number of Predictors (k)	34
F Statistic	481.3
Adjusted R Squared	0.77

00003781

Table A - 9: Full Results for the All Sales Model

	Coef.	SE	p Value	*n*
Intercept	9.08	0.14	0.00	
Nbr LN SP96 hat All OI	0.16	0.01	0.00	7,459
AgeatSale	-0.007	0.0003	0.00	7,459
AgeatSale Sqrd	0.00003	0.000002	0.00	7,459
Sqft 1000	0.28	0.01	0.00	7,459
Acres	0.02	0.00	0.00	7,459
Baths	0.08	0.01	0.00	7,459
ExtWalls Stone	0.21	0.01	0.00	2,287
CentralAC	0.12	0.01	0.00	3,785
Fireplace	0.11	0.01	0.00	2,708
FinBsmt	0.09	0.01	0.00	990
Cul De Sac	0.09	0.01	0.00	1,472
Water Front	0.35	0.03	0.00	107
Cnd Low	-0.43	0.04	0.00	101
Cnd BAvg	-0.21	0.02	0.00	519
Cnd Avg	Omitted	Omitted	Omitted	4,357
Cnd AAvg	0.13	0.01	0.00	2,042
Cnd High	0.22	0.02	0.00	440
Vista Poor	-0.25	0.02	0.00	470
Vista BAvg	-0.09	0.01	0.00	4,301
Vista Avg	Omitted	Omitted	Omitted	1,912
Vista AAvg	0.10	0.01	0.00	659
Vista Prem	0.09	0.03	0.00	117
WAOR	Omitted	Omitted	Omitted	790
TXHC	-0.82	0.02	0.00	1,311
OKCC	-0.53	0.02	0.00	1,113
IABV	-0.31	0.02	0.00	822
ILLC	-0.05	0.02	0.02	412
WIKCDC	-0.17	0.01	0.00	810
PASC	-0.37	0.03	0.00	494
PAWC	-0.15	0.02	0.00	551
NYMCOC	-0.25	0.02	0.00	463
NYMC	-0.15	0.02	0.00	693
Pre-Construction Sales	Omitted	Omitted	Omitted	2,522
No View	0.02	0.01	0.06	4,207
Minor View	0.00	0.02	0.76	561
Moderate View	0.03	0.03	0.38	106
Substantial View	0.03	0.07	0.63	35
Extreme View	0.06	0.08	0.43	28
Inside 3000 Feet	-0.06	0.05	0.23	80
Between 3000 Feet and 1 Mile	-0.08	0.05	0.08	65
Between 1 and 3 Miles	0.00	0.01	0.79	2,359
Between 3 and 5 Miles	0.01	0.01	0.58	2,200
Outside 5 Miles	0.00	0.02	0.76	1,000
Pre-Announcement Sales	Omitted	Omitted	Omitted	1,755

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	6
Model Name	All Sales Model
Dependent Variable	LN SalePrice96
Number of Cases	7459
Number of Predictors (k)	39
F Statistic	579.9
Adjusted R Squared	0.75

00003782

Table A - 10: Full Results for the Temporal Aspects Model

	Coef.	SE	p Value	*n*
Intercept	9.11	0.14	0.00	
Nbr_LN_SP96_hat_All_OI	0.16	0.01	0.00	7,459
AgeatSale	-0.007	0.0003	0.00	7,459
AgeatSale_Sqrd	0.00003	0.000002	0.00	7,459
Sqft_1000	0.28	0.01	0.00	7,459
Acres	0.02	0.00	0.00	7,459
Baths	0.08	0.01	0.00	7,459
ExtWalls_Stone	0.21	0.01	0.00	2,287
CentralAC	0.12	0.01	0.00	3,785
Fireplace	0.12	0.01	0.00	2,708
FinBsmt	0.09	0.01	0.00	990
Cul_De_Sac	0.09	0.01	0.00	1,472
Water_Front	0.35	0.03	0.00	107
Cnd_Low	-0.43	0.04	0.00	101
Cnd_BAvg	-0.21	0.02	0.00	519
Cnd_Avg	Omitted	Omitted	Omitted	4,357
Cnd_AAvg	0.13	0.01	0.00	2,042
Cnd_High	0.22	0.02	0.00	440
Vista_Poor	-0.25	0.02	0.00	470
Vista_BAvg	-0.09	0.01	0.00	4,301
Vista_Avg	Omitted	Omitted	Omitted	1,912
Vista_AAvg	0.10	0.01	0.00	659
Vista_Prem	0.09	0.03	0.00	117
WAOR	Omitted	Omitted	Omitted	790
TXHC	-0.82	0.02	0.00	1,311
OKCC	-0.52	0.02	0.00	1,113
IABV	-0.30	0.02	0.00	822
ILLC	-0.04	0.02	0.05	412
WIKCDC	-0.17	0.02	0.00	810
PASC	-0.37	0.03	0.00	494
PAWC	-0.14	0.02	0.00	551
NYMCOC	-0.25	0.02	0.00	463
NYMC	-0.15	0.02	0.00	693

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Note: Results for variables of interest shown on following page

00003783

	Coef.	SE	p Value	*n*
No View	Omitted	Omitted	Omitted	6,729
Minor View	-0.02	0.01	0.20	561
Moderate View	0.00	0.03	0.97	106
Substantial View	0.01	0.07	0.87	35
Extreme View	0.04	0.07	0.59	28
Pre_Anc_Gtr2Yr_Lt1Mile	-0.13	0.06	0.02	38
Pre_Anc_2Yr_Lt1Mile	-0.10	0.05	0.06	40
Post_Anc_Pre_Con_Lt1Mile	-0.14	0.06	0.02	21
Post_Con_2Yr_Lt1Mile	-0.09	0.07	0.15	39
Post_Con_2_4Yr_Lt1Mile	-0.01	0.06	0.86	44
Post_Con_Gtr5Yr_Lt1Mile	-0.07	0.08	0.37	42
Pre_Anc_Gtr2Yr_1_3Mile	-0.04	0.03	0.19	283
Pre_Anc_2Yr_1_3Mile	0.00	0.03	0.91	592
Post_Anc_Pre_Con_1_3Mile	-0.02	0.03	0.53	342
Post_Con_2Yr_1_3Mile	0.00	0.03	0.90	807
Post_Con_2_4Yr_1_3Mile	0.01	0.03	0.78	503
Post_Con_Gtr5Yr_1_3Mile	0.00	0.03	0.93	710
Pre_Anc_Gtr2Yr_3_5Mile	0.00	0.04	0.93	157
Pre_Anc_2Yr_3_5Mile	0.00	0.03	0.98	380
Post_Anc_Pre_Con_3_5Mile	0.00	0.03	0.93	299
Post_Con_2Yr_3_5Mile	0.02	0.03	0.56	574
Post_Con_2_4Yr_3_5Mile	0.01	0.03	0.66	594
Post_Con_Gtr5Yr_3_5Mile	0.01	0.03	0.68	758
Pre_Anc_Gtr2Yr_Gtr5Mile	Omitted	Omitted	Omitted	132
Pre_Anc_2Yr_Gtr5Mile	-0.03	0.04	0.39	133
Post_Anc_Pre_Con_Gtr5Mile	-0.03	0.03	0.36	105
Post_Con_2Yr_Gtr5Mile	-0.03	0.03	0.44	215
Post_Con_2_4Yr_Gtr5Mile	0.03	0.03	0.42	227
Post_Con_Gtr5Yr_Gtr5Mile	0.01	0.03	0.72	424

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	7
Model Name	Temporal Aspects Model
Dependent Variable	LN_SalePrice96
Number of Cases	7459
Number of Predictors (k)	56
F Statistic	404.5
Adjusted R2	0.75

00003784

Table A - 11: Full Results for the Orientation Model

	Coef.	SE	p Value	*n*
Intercept	7.62	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.33	0.04	0.00	87
Cnd_Low	-0.44	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.13	0.01	0.00	1,445
Cnd_High	0.24	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.03	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.24	0.02	0.00	605
ILLC	-0.08	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.07	0.03	0.01	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
No View	Omitted	Omitted	Omitted	4,207
Minor View	-0.01	0.06	0.92	561
Moderate View	0.00	0.06	0.97	106
Substantial View	-0.01	0.09	0.87	35
Extreme View	0.02	0.17	0.89	28
Inside 3000 Feet	-0.04	0.07	0.55	67
Between 3000 Feet and 1 Mile	-0.05	0.05	0.37	58
Between 1 and 3 Miles	0.00	0.02	0.83	2,019
Between 3 and 5 Miles	0.02	0.01	0.22	1,923
Outside 5 Miles	Omitted	Omitted	Omitted	870
Front Orientation	-0.01	0.06	0.82	294
Back Orientation	0.03	0.06	0.55	280
Side Orientation	-0.03	0.06	0.55	253

"Omitted" = reference category for fixed effects variables
"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	8
Model Name	Orientation Model
Dependent Variable	LN_SalePrice96
Number of Cases	4937
Number of Predictors (k)	40
F Statistic	410.0
Adjusted R Squared	0.77

00003705

Table A - 12: Full Results for the Overlap Model

	Coef.	SE	p Value	*n*
Intercept	7.61	0.18	0.00	
Nbr_LN_SalePrice96_hat	0.29	0.02	0.00	4,937
AgeatSale	-0.006	0.0004	0.00	4,937
AgeatSale_Sqrd	0.00002	0.000003	0.00	4,937
Sqft_1000	0.28	0.01	0.00	4,937
Acres	0.02	0.00	0.00	4,937
Baths	0.09	0.01	0.00	4,937
ExtWalls_Stone	0.21	0.02	0.00	1,486
CentralAC	0.09	0.01	0.00	2,575
Fireplace	0.11	0.01	0.00	1,834
FinBsmt	0.08	0.02	0.00	673
Cul_De_Sac	0.10	0.01	0.00	992
Water_Front	0.34	0.04	0.00	87
Cnd_Low	-0.45	0.05	0.00	69
Cnd_BAvg	-0.24	0.02	0.00	350
Cnd_Avg	Omitted	Omitted	Omitted	2,727
Cnd_AAvg	0.13	0.01	0.00	1,445
Cnd_High	0.24	0.02	0.00	337
Vista_Poor	-0.21	0.02	0.00	310
Vista_BAvg	-0.08	0.01	0.00	2,857
Vista_Avg	Omitted	Omitted	Omitted	1,247
Vista_AAvg	0.10	0.02	0.00	448
Vista_Prem	0.13	0.04	0.00	75
WAOR	Omitted	Omitted	Omitted	519
TXHC	-0.75	0.03	0.00	1,071
OKCC	-0.44	0.02	0.00	476
IABV	-0.24	0.02	0.00	605
ILLC	-0.09	0.03	0.00	213
WIKCDC	-0.14	0.02	0.00	725
PASC	-0.31	0.03	0.00	291
PAWC	-0.07	0.03	0.00	222
NYMCOC	-0.20	0.03	0.00	346
NYMC	-0.15	0.02	0.00	469
No View	Omitted	Omitted	Omitted	4,207
Minor View	-0.03	0.02	0.10	561
Moderate View	-0.02	0.04	0.67	106
Substantial View	-0.05	0.09	0.57	35
Extreme View	-0.03	0.10	0.77	28
Inside 3000 Feet	-0.05	0.06	0.41	67
Between 3000 Feet and 1 Mile	-0.05	0.05	0.38	58
Between 1 and 3 Miles	0.00	0.02	0.82	2,019
Between 3 and 5 Miles	0.02	0.01	0.22	1,923
Outside 5 Miles	Omitted	Omitted	Omitted	870
View Does Not Overlap Vista	Omitted	Omitted	Omitted	320
View Barely Overlaps Vista	0.05	0.03	0.09	150
View Somewhat Overlaps Vista	0.01	0.03	0.67	132
View Strongly Overlaps Vista	0.05	0.05	0.31	128

"Omitted" = reference category for fixed effects variables

"n" indicates number of cases in category when category = "1"

Model Information

Model Equation Number	**9**
Model Name	**Overlap Model**
Dependent Variable	**LN_SalePrice96**
Number of Cases	**4937**
Number of Predictors (k)	**40**
F Statistic	**409.7**
Adjusted R Squared	**0.77**

00003786



- Approxmimate residential locations

Radius

- ○ Miles
  and 2 mile radius

Exhibit # 43

00003787

#39

From: Chrissy Froese
81310 Gerking Flat Rd.
Athena, Oregon 97813

March 17, 2011

To: Umatilla County Land Use Committee and other associated interest groups.

My husband and I are farmers outside of Athena 7 miles. We live within 1/2 mile of the recent turbines installed off of Gerking Flat Rd a year ago. The latest turbines that were installed do prove to perform as Florida Power represented to us before they installed the project. These turbines are the latest and most effective in the country as well as being relatively quiet compared to earlier turbines installed in former projects.

The closest turbine is about 1/2 mile accross a ravine facing our front porch. This turbine is no louder on a day that the wind carries the sound, which is not very often, towards our home, is less of a hummm than what the neighbors wheat silo puts out after harvest grain has been installed into the containers. Again Florida Power represented this noise factor fairly accurate.

The next project purposed for 2012 is to be designed to take in part of our farm acerage as well as a few other farms further down Gerking Flat Rd. We are excited about this venture. For we, along with most farmers, have struggled to stay in business due to high cost of farming. This project will enable us to still carry on the agriculture business and represent a wind farm. We will then have three commodoties; wheat, cattle AND wind.

We are not bought off by the revenue represented by the turbines, but rather encouraged to be a part of a clean energy performing business. These turbines are going to also be an opportunity to bring revenue to our county.

A few months ago, the East Oregonian represented an article that had taken a picture of our home and turbines, without permission, North of us with the article siding with those who complained about noise of a whole different project with much less functioning power and wth more noise output down the Vansycle canyon. I called the reporter and asked if she considered coming and talking to us and listening from our front porch. She had not, actually no one has come over to our home that seem to have such anti opinions about the progress of the wind projects and progress in energy.

Lastly, what happened to free choices of our own land and its uses? What about the Amerian Dream.....progress by free choice?
The wind turbines can enrich our business operation; add more clean power to use or sell for those in need; and bring revenue to our county. So what is the problem?

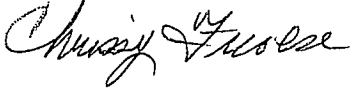
Starting years ago farmers built silos, used combines, trucks,

and tractors to farm which all have large motors and fuels as well as chemicals that make noise, Shouldn't we also have the right to allow structures that can make a sound that also bring revenue to our own land other than wheat, and cattle? If the land use boards in our county begin to restrict or put unreasonable laws into effect, then will they eventually impose laws that we won't be able to farm any closer than 2 miles from a farm dwelling or resident?
Farm machinery output much more noise and pollution than any turbine I have been exposed to by far.

I am convinced since no one has called, written, or stopped by for accurate facts concerning our neighbors turbines how can they have an honest report? How can any educated decisions be made in such an ignorant fashion concerning the newest turbines in the world outside our front door?

My husband and I would love to invite anyone to come to our personal home have a cup and tea and listen to the whispers of the turbines that adorn our landscape from a distance. You will be pleasantly impressed.

Sincerely,
Chrissy Froese, wife, partner of Froese Farms



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March 17, 2011

RECEIVED

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UMATILLA COUNTY
PLANNING DEPARTMENT

Dear County Commissioners:

I have read the new county wind ordinance and while I understand the need for some set backs, I hope you will reconsider the requirement for set backs on gravel roads with few or no houses such as Coe Road, Lincton Mountain Road, and Basket Mountain Road. Parts of these roads are on narrow ridges and large set backs would make wind turbine development too difficult to be economically feasible.

Craig Pritchard

Craig Pritchard

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Commisioners:

My name is Richard Stewart. I reside at 515 Fleetwood Ave. College Place. WA. I own property in Umatilla County.

What bothers me the most is the set back regulations approved by the planning commissioners. The 2 mile set back from a residence for placement of wind turbines. This set back is not 2 miles, but actually a 4 mile radius. To give you an ides of how far2 miles are : From the Umatilla River up Hwy 11 to the Truck Sales yard is 2 miles.Wild Horse turn off is 4 miles from the Umatilla River. In Milton-Freewater from Crockett Rd. to Stateline is 2 miles.

With Mr. Jolly who lives approx 1 miles up Upper Dry Creek Rd. and Mr. Burns, who lives on Hodgen Rd. have an 8 miles area they can object to the placement of anything they feel is view or noise objectionable. So no landowner is safe from their objecting to any structure they (the landowner) would want to erect on their own property. This same scenario could be used by any landowner in Umatilla County.

Anytime you try to regulate view and noise you will find that both are viewed differently by everyone. Some people even use it for monetary gains.

As for the set back from cities! ! Have you asked all of the cities if they want the 2 miles set back? There are some cities that use wind turbines to recharge their city vehicles. This will become more prevalent as we have more electric vehicles in use.

Landowners should be able to use their land as they see fit. I believe either the State or Federal Government will declare Wind Farming a farming practice. This would make measure 39 or 47 come into play. Land owners need protection from over regulations which inhibit their ability to use their property wisely.

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Along these same lines would be the Federal or State Government could enact a statue or laws saying you cannot have any farming practice within 500 yds. of any waterway.This would include any domestic animals. It would make your land useless to you. This piece of legislation we are discussing now does the same thing .Would anyone be in favor of this 2 mile set back regulation?

Our neighbors to the north , Walla Walla & Walla Walla County have not come into the discussion of Wind Farms because they know you have to have the economic base to sustain a County & City.

Once you have a law or regulation enacted there is someone out there wanting to change it to include other farming, logging or business practices. The Blue Mt. Alliance has done just that with this regulation.

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Confederated Tribes of the
Umatilla Indian Reservation

Board of Trustees

Exhibit 41

46411 Timíne Way
Pendleton, OR 97801

www.ctuir.org email: info@ctuir.org
Phone 541-276-3165 Fax: 541-276-3095

Testimony of Leo Stewart, Vice-Chairman, Board of Trustees
Confederated Tribes of the Umatilla Indian Reservation

Hearing on Umatilla County Commercial
Wind Power Generation Facility Siting Standards
9 a.m., March 17, 2011

I am Leo Stewart, Vice-Chairman of the Board of Trustees of the Confederated Tribes of the Umatilla Indian Reservation. Thank you for the opportunity to speak. I am here today to express the Umatilla Tribes' support for the proposed Wind Power Generation Facility Siting Standards.

The Umatilla Tribes have watched the development of wind power on the Columbia Plateau and participated in wind development. We recognize the importance of renewable energy, but we also recognize the impacts of energy development on resources the tribes depend on for our livelihood. We have seen these impacts over the last 150 years. We hope that these rules and their implementation can rise to meet the challenge of promoting energy development while preserving the quality of life of all in the region.

Since Umatilla County first adopted wind development rules in 1999, the County has been a leader in attempting to preserve our natural resources. Even today, the Umatilla County rules for wind development are viewed as a model for other counties to build upon. Over the last decade we've seen a dramatic increase in wind development that has resulted in cumulative impacts to natural and cultural resources which were not foreseen at this scale. The regulations before you today refine and revise the Umatilla County rules based on the experience within the region of wind power development. These rules provide more certainty and defined standards that will benefit both industry as well as adjacent landowners while protecting the interests of all residents of Umatilla County.

The Umatilla Tribes adopted our Energy Policy in 2009 that recognized large scale wind energy projects "can impact important natural resources or destroy the view shed and quietness of residential areas." We believe that these draft rules go further than existing county rules to protect the important natural and cultural resources which we all depend on.

The Umatilla Tribes understand that these standards do not satisfy everyone, but we feel that they strike an important balance needed to allow development while preserving our natural and cultural resources. In the future, if there are revisions to this rule, Umatilla Tribes would like to see specific requirements for pre-construction study of natural and cultural resources which can

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be impacted by wind development. Further, once a facility is operational, if it is determined that it is having unforeseen adverse effects on wildlife habitat or other cultural or natural resources, limitations on operations may be imposed. Finally, there are areas that should be studied to determine whether or not they are suitable for wind development due to high resource values and potential for harm such as around the Walla Walla River.

In closing, I would like to point out that the things that are most important to our quality of life do not change quickly, but tend to change over the long-term. These rules, if enacted, will require more careful examination of what we are giving up by permitting development. Thank you.