

# Pleasant Ridge Sound Study Data

By  
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Exhibit 3

## Why did I do this?

- Both the originally filed PR application and the amended application appeared over the IPCB limits to me. Their use of rounding, and only looking at the middle of houses (not property lines), and limiting the shown data to the 107 worst receptors, didn't satisfy me.
- When the applicant was told (during ZBA hearings) that rounding down wasn't acceptable, they proposed 20 more LNTE blades to fix the problem, but didn't show their work, or give any results.
- We have no data or contour maps to help evaluate how people living nearby may be affected.
- To clarify: **For the currently proposed 24-LNTE wind farm that is on the table, we have not been given any sound study model results or data or proof of compliance.**

## What data were we given?

- 1) Original PR application (Aug 2014) showed a table of predicted octave band noise levels, rounded to nearest integer, at the 107 worst receptors for the GE 1.79-100 turbines.
- 2) PR amendment (Oct 2014), added the same data for the GE 1.72-103 turbines, removed turbine 090, and gave revised data for GE 1.79-100 turbines. All rounded to nearest integer.
- 3) Jan 2015 (?), PR Exhibit 16A gave a list of 24, 100m turbines and 20,103m turbines that need LNTE blades to "*ensure that predicted noise levels do not exceed 41.0 dB in the 1,000 Hz octave band or 47.0 dB in the 500 Hz octave band (without rounding). With this, levels in all other bands are well below their respective criteria.*" No new data given.
- 4) Jan 21<sup>st</sup>, ZBA, Mr Griffin (for the county) asked the applicant for the predicted octave band levels to the nearest tenth. I couldn't find that followup exhibit.

## So I ran the numbers myself

- I am a professional computer programmer, we write computer programs that people use to solve problems.
- I wrote a C++ program to implement ISO 9613-2. ISO 9613-2 is a relatively simple algorithm, not many lines of code needed. Compared to the large man-year type projects that I usually work on, this only took a few days, really simple stuff.
- I verified that I matched all PR 107 Receptors 1000Hz Octave Band for GE 1.79-100 data within 1 dB.
- The code can calculate an entire 2000x2000 image in a few minutes, that's how simple it is.

# ISO 9613-2 Accuracy

- ISO 9613-2 is nothing more than an approximation to make the math of a very complex problem, simple.
- Very similar to counting seconds between lighting strike and thunder and dividing by 5 to figure miles away. Obviously they skip a lot details and specifics, but give a “good enough” answer.
- ISO 9613-2 has fundamental errors just because of what it is: A simplification.
- They essentially say “take all this blah blah and approximate it using this simpler math and a table lookup”. Of course there is error. It’s close, yes, under very specific conditions.
- We are using a delta height of almost 80m (above their recommended 30m max) and using distances of miles, not just 1000 m or less (See Table 5 below from the ISO 9613-2 specification.)

Table 5 — Estimated accuracy for broadband noise of  $L_{AT}(DW)$  calculated using equations (1) to (10)

Height, $h$ <sup>*1</sup>	Distance, $d$ <sup>*1</sup>	
	$0 < d < 100$ m	$100 \text{ m} < d < 1\,000$ m
$0 < h < 5$ m	$\pm 3$ dB	$\pm 3$ dB
$5 \text{ m} < h < 30$ m	$\pm 1$ dB	$\pm 3$ dB

<sup>\*1</sup>  $h$  is the mean height of the source and receiver.  
 $d$  is the distance between the source and receiver.

NOTE — These estimates have been made from situations where there are no effects due to reflection or attenuation due to screening.

## How does ISO 9613-2 relate to PR?

- The applicant used ISO 9613-2 to model or predict the worst case sound levels at each sound receptor by using the worst case conditions (WCC), (most conservative values), for any allowed inputs to the calculation.
- I will call using ISO-9613-2 to model the Worst Case Conditions, IWCC for short.
- From the PR Application's Sound Study: *“model results are expected to be higher than the actual noise levels expected at a given receptor.”*

# Let me clarify things...

Here is a real-world example of how IWCC Predictions relate to real life measurements, just to show the kind of numbers we're talking about and how they vary.

- We just need two pieces: A validated measurement and a model.
- Puzzle Piece 1: “The measurement” PR Exhibit 48, Noise Level Compliance Analysis for the California Ridge Project, specifically, monitored location Prime 2, which included wind speed measurements.
- Puzzle Piece 2: “The model” Using ISO 9613-2 Worst Case Conditions (IWCC), I modeled IWCC Predicted @ 1000Hz for Prime 2 (Answer:39.8 db).
- So the readings should be 39.8 db worst case, according to IWCC Predictions.

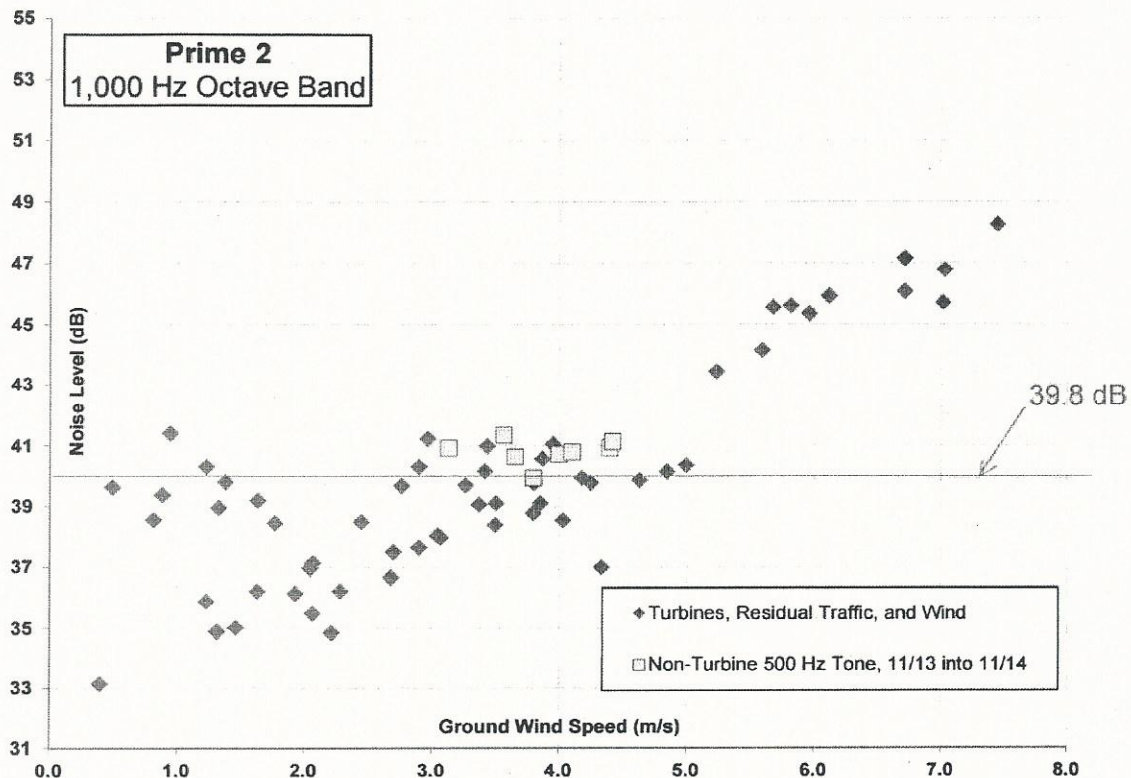


Figure 7-1: Noise Levels versus Ground Wind Speed – Prime 2

## PR Siting History

- Aug 20<sup>th</sup>, 2014 application, 4 LNTE blades
- Oct 15<sup>th</sup>, 2014 supplemental application, 4 LNTE blades (plus -103m turbines).
- Unknown Date before Nov 18<sup>th</sup>, 2014, 11 LNTE Blades. (Hankard Testimony, Nov 18th 2014, PR ZBA "**We got to that point on this project and we were a little bit over the noise limits, so that's when we started adding in these turbines with the lower, the low noise trailing edge blades.** Initially, we found out we needed four of them on the turbines, that I believe we went over where those are last night. Then at one point **I said to the project, you know, we're actually one to two-tenths of a decibel over the limit in one of the bands. And they said, well, what does it take to get rid of that? And we said another 7 LNTEs.** And Invenergy said, fine, let's do that.")
- Jan 21<sup>st</sup>, 2015: 24 LNTE blades. Mr Griffin (looking at 4 LNTE data): "I would ask that the applicant -- although I understand your position that that was appropriate to round down, I would ask the applicant to assume that that position was not agreed to by the county and identify what the solution or the remedy would be so that the model would demonstrate compliance at all the receptors." Mr Blazer replied: "we also have marked as Pleasant Ridge Exhibit 16A, this would be the updated list. The current list shows I think four of the 103 turbines with LNTEs and 11 of the 100 turbines with LNTEs. This new list, which I've marked as 16A, shows 20 of the 103s and 24 of the 100s."
- This is "reactionary siting", doing just what you need to do to stay on the ragged edge of the legally allowed IPCB limits, no room for error or unknowns. It is certainly not designing to minimize impacts on the nearby non-participants.

## ISO 9613-2 Worst Case Condition (IWCC) Model Summary

- As we see from the graph of real-world data, the California Ridge compliance study shows that the predicted ISO 9613-2 Worst Case Condition (IWCC) levels are within the boundaries of what actually gets measured, but it certainly isn't a hard upper limit on what we'd ever see.
- Placing turbines right up to the ragged edge of IPCB limits using the ISO 9613-2 Worst Case Condition (IWCC) approximation as a prediction model is probably not the best method of turbine siting. But that is exactly what happened here for PR.

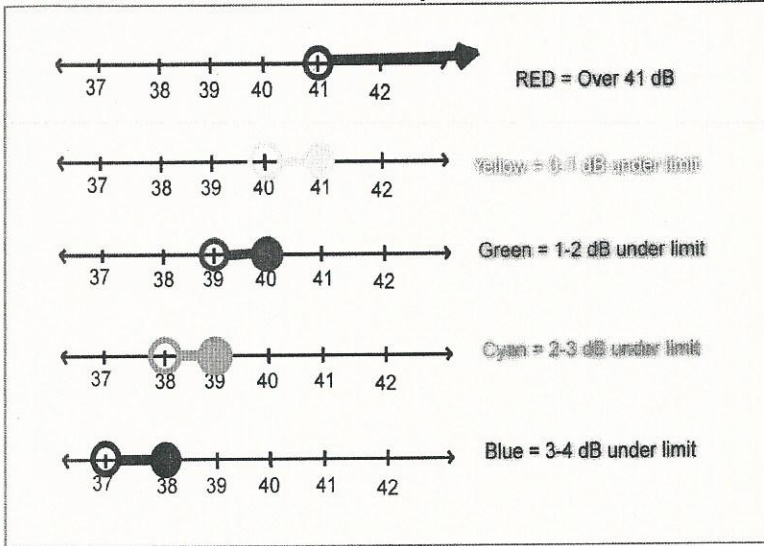
## My Model: Contour Maps

I generated some contour maps to visualize the following, all in the 1000Hz Octave Band.

- The original PR application's (4 LNTE) siting
- The PR Exhibit 16A (24 LNTE) siting
- The California Ridge project siting, specifically to compare to Ted Hartke's abandoned home.
- A map of all homes with IWCC predicted levels at or worse than Hartke's.

# Legend for ALL slides

- All slides are the 1000 HZ Octave Band contours
- Black Circle = House
- White Circle = Turbine
- White Circle with Purple Ring = LNTE Turbine

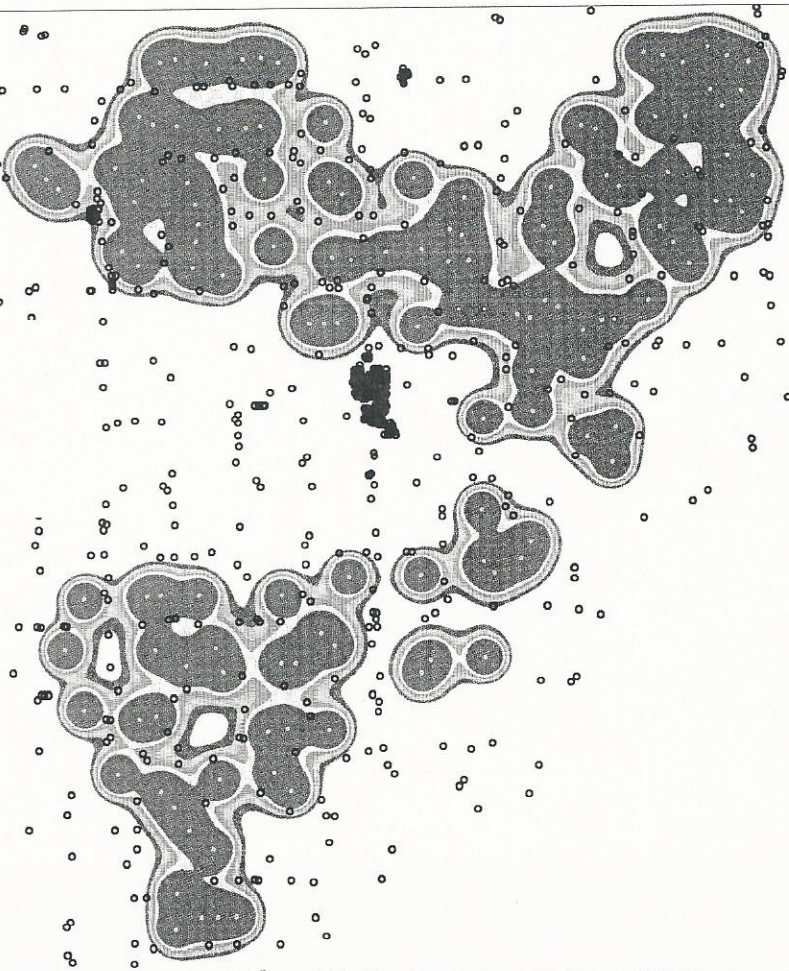


NOTE: For the contour colors, I did NOT round 41.499 to 41.0. Anything over 41 is red. Yellow is within 1 db of hitting the limit. Green is within 2 db, and so on and so forth.

Fig 1  
1000 Hz Octave  
Band Contours

Original 8/20 PR  
application Data,  
4 LNTEs.

Quite a few points  
are clearly over  
the IPCB limit of  
41 dB.



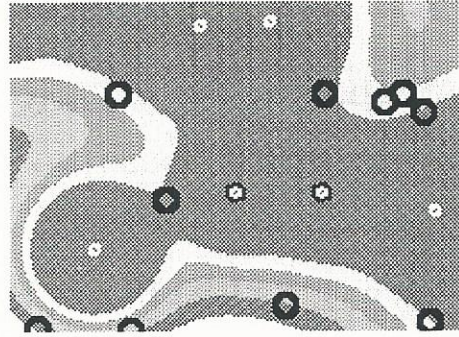
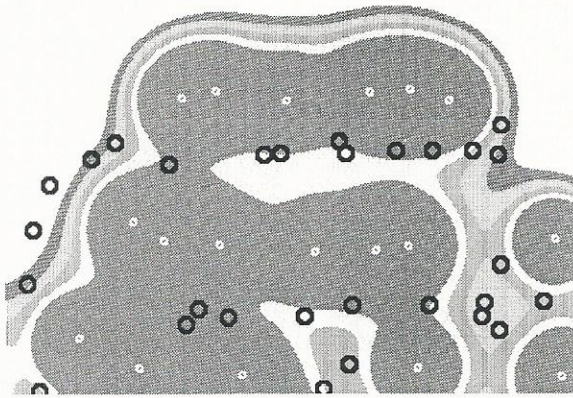


Fig 2  
1000 Hz Octave  
Band Contours

Original 8/20 PR  
application Data,  
4 LNTs.

Zoomed in on a  
some of the bad  
areas.

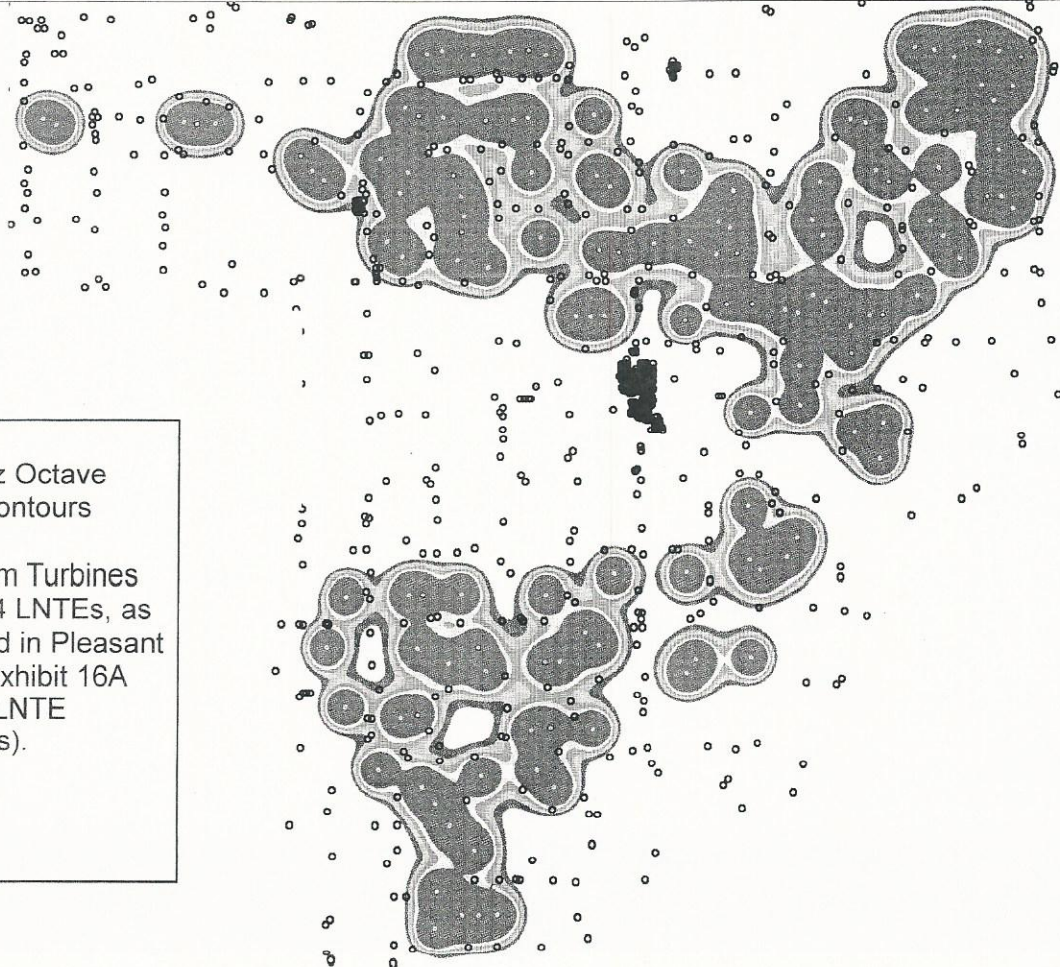
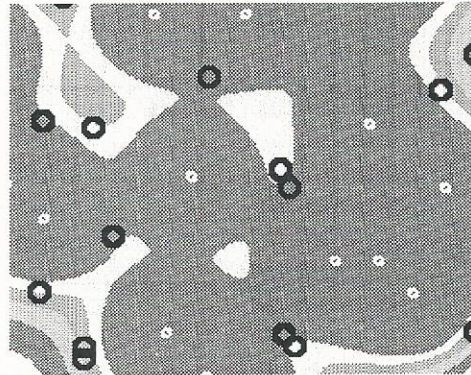
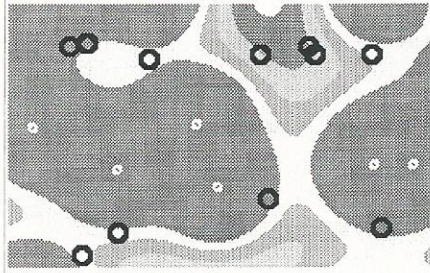


Fig 3  
1000 Hz Octave  
Band Contours

PR 100m Turbines  
using 24 LNTs, as  
specified in Pleasant  
Ridge Exhibit 16A  
(List of LNT  
locations).



Fig 4  
1000 Hz Octave  
Band Contours

PR 100m  
Turbines using  
24 LNTE data  
from Pleasant  
Ridge Exhibit  
16A (List of  
LNTE  
locations).

Zoomed in on  
some of the bad  
areas.

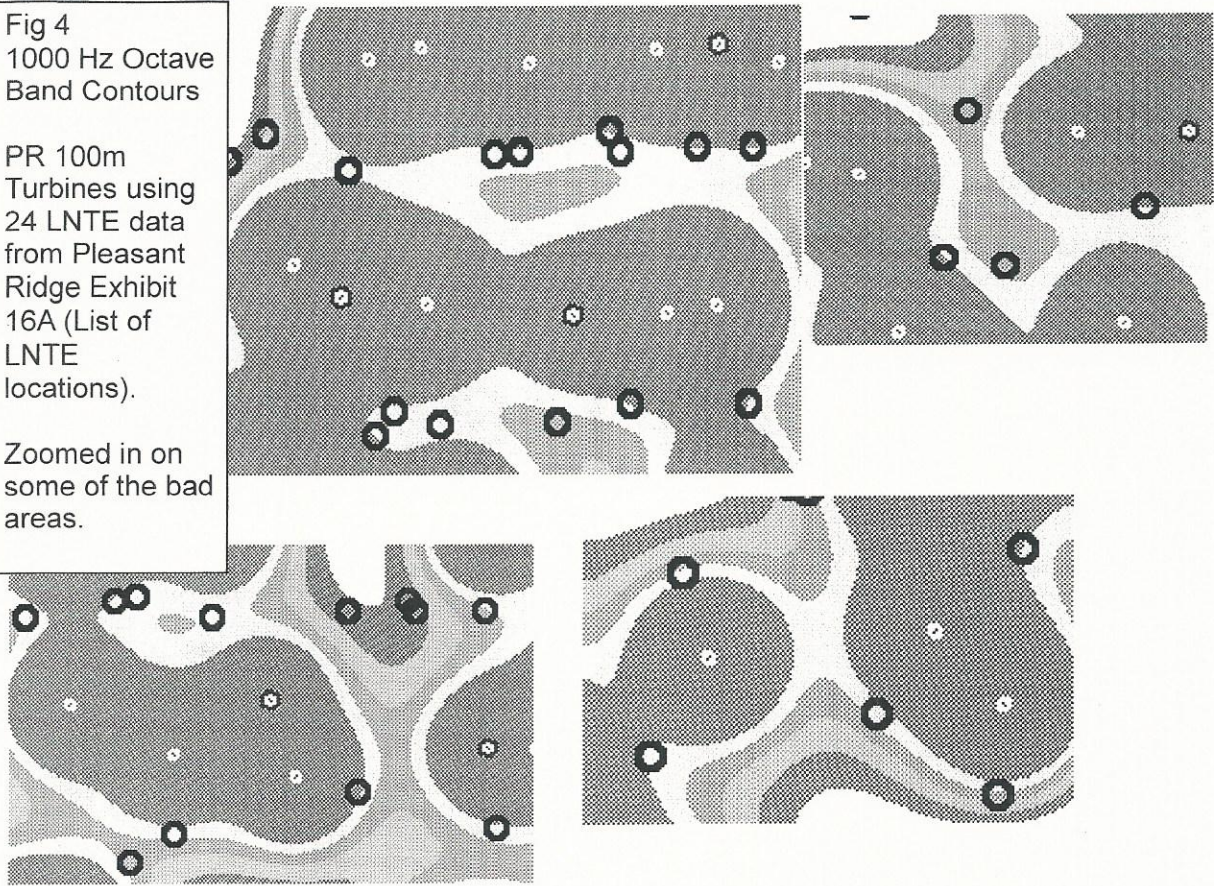


Fig 5  
1000 Hz Octave  
Band Contours

California Ridge

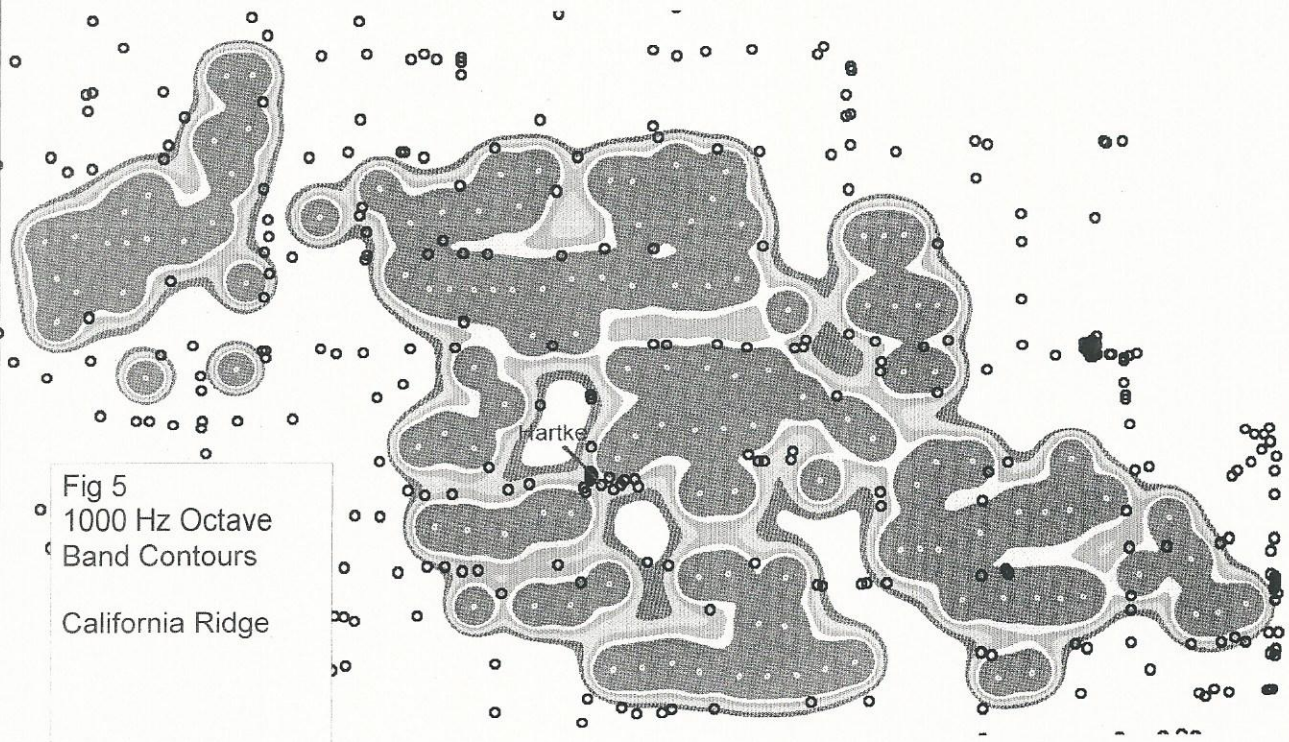


Fig 6  
1000 Hz Octave Band Contours

California Ridge

Zoomed in on Ted Hartke's home.

Calculated ISO9613-2 WCC 1000HZ db @ Hartke's is  
39.16 db, this is the Green Range (1-2 db below limit)

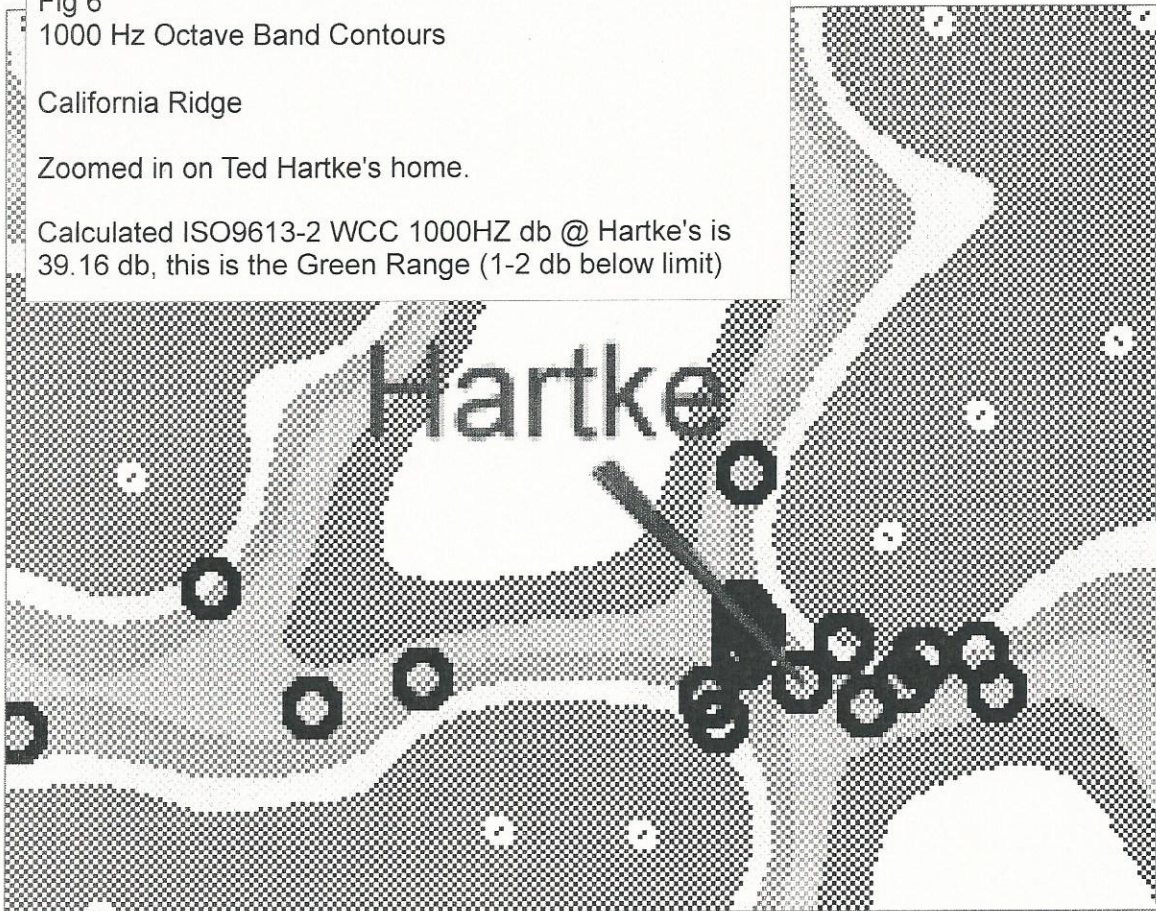


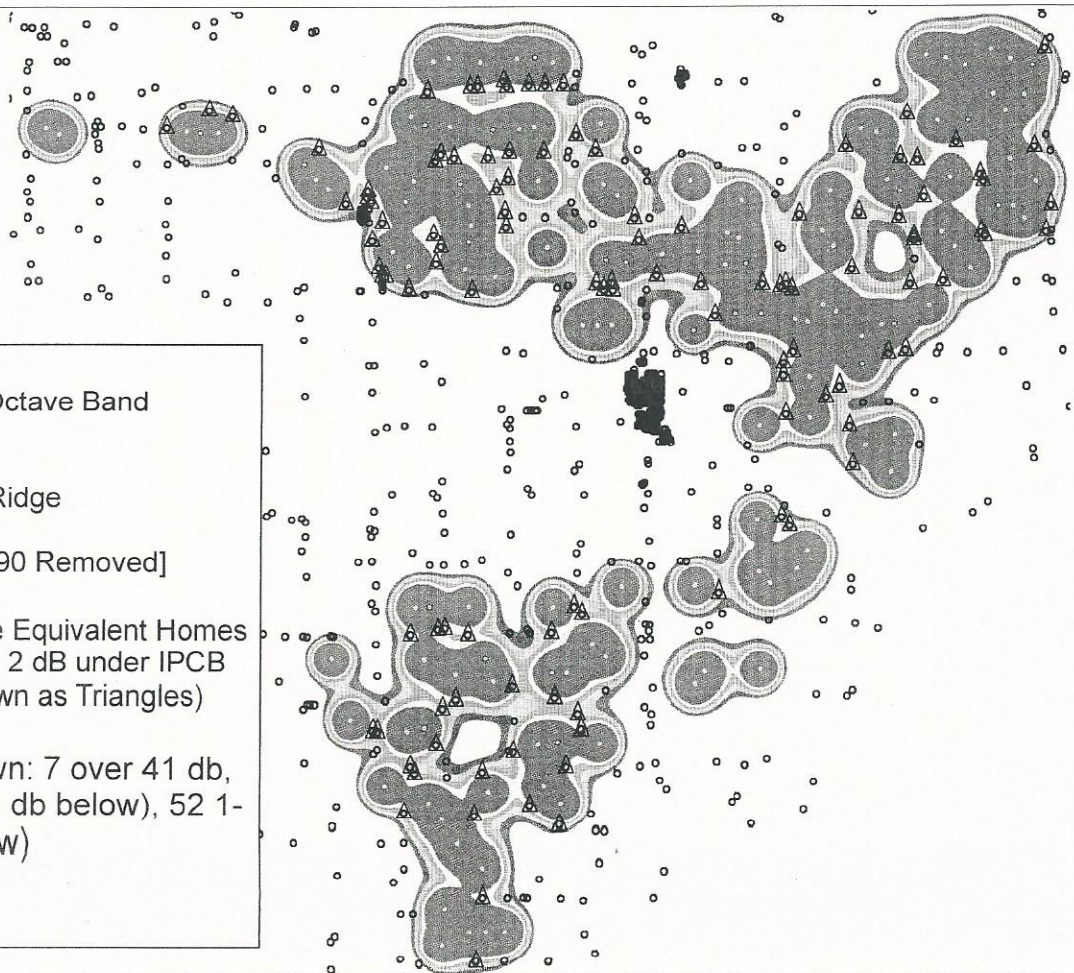
Fig 7  
1000 Hz Octave Band  
Contours

Pleasant Ridge

[Turbine 090 Removed]

114 Hartke Equivalent Homes  
(Less than 2 dB under IPCB  
limits, shown as Triangles)

Breakdown: 7 over 41 db,  
55 at (0-1 db below), 52 1-  
2 db below)



# Final Summary

- The original PR application (4 LNTE blades) was clearly over IPCB limits for many cases. My calculations show this and Hankard also stated this.
- The 24 LNTE blade siting is still slightly over IPCB limits, according to my IWCC model.
- For 24 LNTE blade siting, we have no data demonstrating compliance with IPCB limits from the applicant.
- The current PR siting is reactionary to stay on the ragged edge of the legally allowed IPCB limits.
- Ted Hartke's abandoned house is in the 1-2 dB under IPCB 1000 Hz nighttime limit range (Green). With the current 24 LNTE siting, any my calculations, there are 114 homes in the proposed Pleasant Ridge Wind farm in that same range or worse.
- Does the applicant seem more focused on staying just under legal limits (protecting themselves) or minimizing effects on nearby families who were here first (protecting us)? THE END

