association to protect
AMHERST ISLAND

Napanee Generating Station

A Detailed Response to the Ministry's Review of Issues Raised by APAI - Noise Concerns

1) APAI: ISO 9613 model does not address noise propagation over water

MOECC Response:

> TransCanada prepared sound level predictions in accordance with the ISO 9613-2 model, an international standard that has been developed for application to industrial facilities such as the Napanee Generating Station. It is also the accepted standard model used in Ontario by the Ministry of the Environment and Climate Change and consultants. TransCanada has acknowledged that the standard does not account for the effect of strong temperature inversions such as those that may occur over water, and has used a conservative approach by applying appropriate meteorological corrections to their predicted levels. The ISO 9613-2 model takes the acoustical properties of each ground region into account, hard ground, porous ground, and mixed ground; water is considered a hard ground. By accounting for the type of ground the sound is travelling over, the model accounted for the rebound effect of sound over water and the resulting potential amplification. Ministry of the Environment and Climate Change noise engineers are satisfied with the modeling done and state that sound propagation over water was accounted for with the ISO 9613-2 model. An Environmental Compliance Approval for noise will be required from the Ministry of the Environment and Climate Change prior to the Project progressing.

APAI Response: TransCanada and MOECC accept that ISO-9613 does not account for predicting the propagation of sound over water. MOECC writes that TransCanada used a conservative approach by applying appropriate meteorological conditions to their predicted level; it did no such thing, merely adding 5 dBA in an *ad hoc* fashion. A ground parameter of zero is just one aspect of determining the propagation of sound over water.

The MOECC noise engineers are well aware, or should be, that ISO-9613 does not account for the propagation of sound over water. That is why MOECC has, as of this month, put out to tender a request for a literature search for the propagation of noise from off-shore wind turbines. See: http://www.canadasbiz.net/bid-opportunities/2014/09/05/province/56/5848850-RFP--Technical-Evaluation-To-Predict-Offshore-Wind-Farm-Noise-Impacts-in-Ontario.html

As is well known to the MOECC engineers, John Harrison (APAI) wrote a report on the propagation of sound over water from off-shore wind turbines. This report was based upon the so-called Swedish model and experimental validation of the model; this was government-sponsored research work.

The MOECC may or may not know that the UK Institute of Acoustics has recently released, in draft form, Supplementary Guidance Note 6: Noise Propagation over Water for On-shore Wind Turbines. See: http://www.ioa.org.uk/sites/default/files/IOA-GPG-SGN-No-6-Consultation-Issue-Dec-2013.pdf

The working group for the document was made up of acoustics engineers from 5 UK consulting companies, known for their work on behalf of the UK wind industry. The working group recommendations 2.2.1 and 2.2.2 are word for word extracted from the report that John Harrison wrote, including the pedantic explanations of the terms in the prediction formula that is his style! (see the Appendix to this report) He does not know any of the working group and did not have any input into their work. However, his work will have come to the attention of planners in the UK because of his input to the proposed Navitas Bay off-shore wind energy development. The only difference is that, based upon the Swedish work, he proposed two prediction equations: one for the average sound pressure level at a receptor and one for the higher sound pressure level to be exceeded 10% of the time. The working group used only the equation for the average level.

2) APAI: The Swedish model should have been use to assess sound propagation over water from the Napanee Generating Station

MOECC response:

> The Ministry of the Environment and Climate Change noise engineers reviewed the Swedish model which is specifically used for wind turbine assessments and determining off-shore wind turbine noise impacts in Sweden. The Swedish model is not a universally used model, whereas the ISO 9613-2 model is used internationally. The ISO 9613-2 is an approved model by the Ministry of the Environment and Climate Change and is commonly used nationally and internationally for the assessment of industrial noise. The ISO 9613-2

> calculation method was specifically designed for industrial sources and provides an accurate prediction of sound attenuation along each individual source-to-receiver propagation path with consideration given to geometrical divergence, atmospheric absorption, ground effect and screening by obstacles. The Ministry of the Environment and Climate Change noise engineers determined that the ISO 9613-2 model used for the Project is the appropriate model for noise prediction.

APAI Response: ISO-9613 is indeed used internationally to describe the propagation of industrial noise, <u>but not for the propagation of noise over water.</u> Although the motivation for the Swedish work was to describe wind turbine noise from off-shore turbines, the modelling was generic and validated with tonal sources at 80, 200 and 400 Hz. Sound is sound whether generated by industry, traffic or wind turbines. The amplitude, spectrum and periodic character are different of course but sound is always a pressure wave in the air. To deny that the Swedish model should be used because it was designed for wind turbine noise is nonsense.

The MOECC noise engineers may have decided, without any reason, that the Swedish model should not be used. However, as noted above, acoustics engineers from Hoare Lea Acoustics, RD Associates, Northern Group Systems, Hayes MacKenzie and Parsons Brinkerhoff, together with a peer reviewer from a separate group, decided otherwise. Furthermore this group writes in their preamble: *"There is little published research or guidance on the propagation of noise over water in the UK. ISO-9613 considers the water surface as being hard, but this does not explain the under-predictions found on some sites where large bodies of water are found between source and receiver."*

3) APAI: Background sound levels for Amherst Island are not accurate due to a windy season.

MOECC Response:

> The background noise data for the receptor on Amherst Island reported in the Environmental Review Report was collected over a period of one month, November 1, 2013 to December 4, 2013. The noise monitoring was completed in accordance with Ministry of the Environment and Climate Change noise guidelines, such as NPC-300, and exceeded the minimum expected number of hours required to characterize background noise. The Ministry of the Environment and Climate Change guidelines require a minimum of 48 hours of continuous noise measurements to be taken to establish background sound levels. Over 700 hours of noise data was logged at the Amherst Island receptor over the one month period. As well, the Ministry of the Environment and Climate Change guidelines do not provide any requirements to complete monitoring in a specific time of year. It can be concluded that the measurements are indicative of the Amherst Island environment where over the course of the monitoring period, varying sounds of nature, wind and wave noise, and other local and mainland sources of noise all contribute to sound levels in the area. The Environmental Review Report acknowledges that there will be hourly periods where the baseline noise level will be less than the measured level. However, the frequency of these periods is relatively low and the hourly sound levels represented in the report are more common.

APAI Response: MOECC is well aware that Amherst Island is a class 3 environment, with background noise well below 40 dBA. APAI does not believe the noise measurements made at point of reception 4 represent the background sound pressure level on Amherst Island. The measurements need to be repeated under MOECC supervision and further from the shoreline. APAI does know that at the time the measurements were made, November 2013, the wind speed was unusually high. In an earlier response to MOECC and TransCanada APAI demonstrated that there was a significant correlation between the sound pressure level measured by the noise consultants and the wind speed recorded at an amateur meteorological station along the north shore of the island. The noise consultants did not publish their own wind speed data, perhaps omitting to measure wind speed.

The unusually high winds during that month can be demonstrated visually from Figure 1 below. From the IESO hourly wind generation data for the nearby Wolfe Island wind energy generating station the monthly average capacity factor (efficiency) can be calculated. This has been done for the 61 months of operation since its start in 2009. The figure shows the number of months for which the capacity factor was given by the percentages along the lower axis. There were just three months for which the average monthly capacity factor exceeded 45%[1]: October and November 2013 and January 2014. The overall capacity factor over the 61 months was 28%. Those of us living on the island know that winter 2013/2014 was brutal with ice storms, very high winds and waves (until the lake froze), and multiple snow squalls. This was no time to be measuring the ambient sound pressure level!

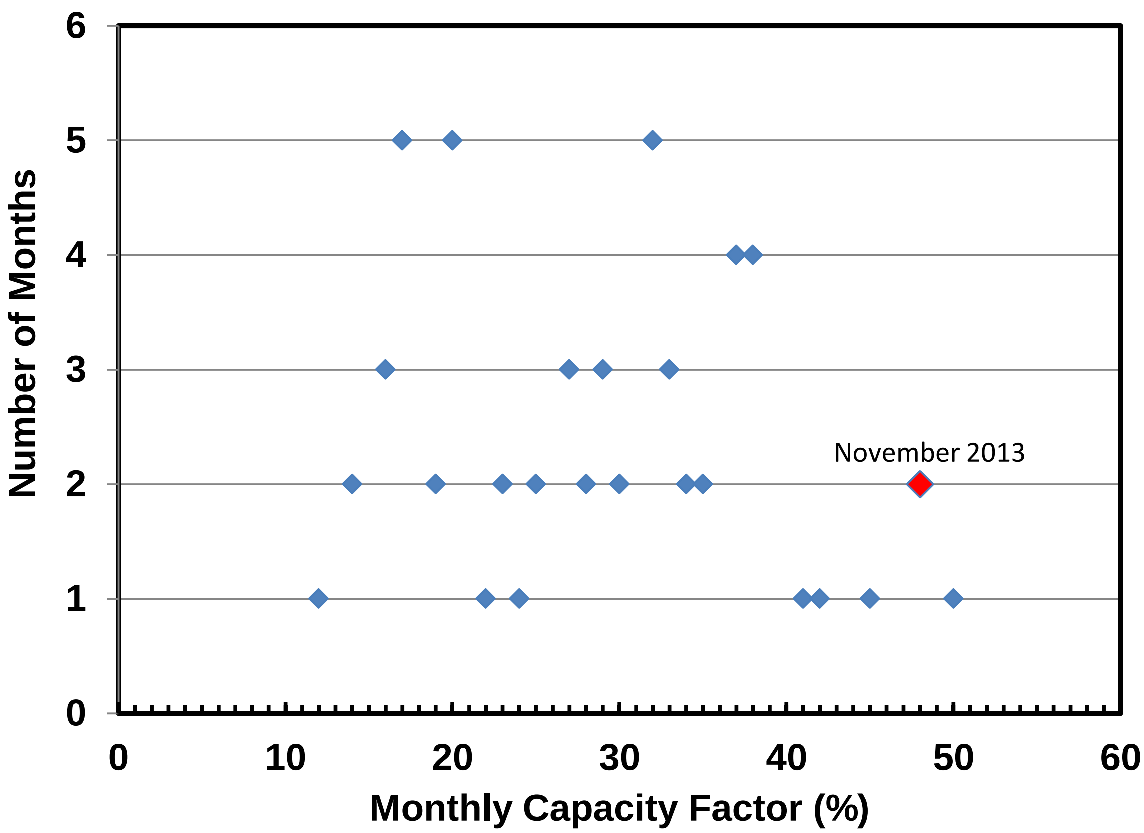

Figure 1: The number of months over the period June 2009 to July 2014 for which the capacity factor of the Wolfe Island Wind Energy generating Station produced a capacity factor given by the percentages along the lower axis. For instance, the capacity factor was 32% for 5 monthly periods over the 5-year interval that Wolfe Island has been operating.

As a further demonstration of the outlying character of the wind speed, the following table shows the archived average monthly wind speeds for Kingston for the past 12 months.

[1] A capacity factor of 48% would be considered high for an off-shore turbine operating in the North Sea!

Monthly Wind Speed data for Kingston[2]

Month	Maximum	Mean
Sep 2013	39.00 km/h	14.12 km/h
Oct 2013	52.00 km/h	15.88 km/h
Nov 2013	58.00 km/h	21.18 km/h
Dec 2013	48.00 km/h	15.75 km/h
Jan 2014	52.00 km/h	19.59 km/h
Feb 2014	57.00 km/h	15.27 km/h
Mar 2014	49.00 km/h	17.33 km/h
Apr 2014	50.00 km/h	15.58 km/h
May 2014	36.00 km/h	13.70 km/h
Jun 2014	34.00 km/h	12.16 km/h
Jul 2014	48.00 km/h	14.07 km/h
Aug 2014	48.00 km/h	13.48 km/h

In our previous response to the sound pressure level measurements we suggested that the possible reasons for not accepting the measurements as representative of the ambient sound pressure level on the island were: wind noise in the microphone; wind noise in the high winds from nearby vegetation; wave noise if the microphone were placed close to the shoreline. Without more details of the placement of the sound monitor and with no concurrent wind speed data it is difficult at this time to differentiate between these causes.

The following test gives some indication of the relative contributions. As of this writing, the wind speed on the island is fairly high, is directly onshore to where I live and there are white-caps on the waves. A sound pressure level measurement near the lake was 68±2 dBA and fairly steady. At a position back from the lake about 50 metres or so the sound pressure level varied from under 40 dBA to 55 dBA; this variation reflects the gustiness of the wind and the fact that the foam wind shield has a diameter of only 4 cm. Note that on this windy day, moving back just 50 metres or so from near the shore, away from the breaking waves but among more trees and shrubs, sound level was reduced by about 20 dBA[3]. Environment Canada shows the wind speed to be 26 km/h with gusts to 36 km/h at Kingston Airport (September 10 at 10:30am). When the wind speed is below 15 km/h the noise meter, with a low limit of 40 dBA, does not register

[2] http://kingston.weatherstats.ca/charts/wind_speed-1year.html

[3] Treating the breaking waves as a line source, we expect a decrease of 3 dBA per doubling of distance, or 12 to 15 dBA for 4 to 5 doublings. The extra reduction is because the sound meter was below the "line of sight" to the waves breaking below a 1 metre high erosion "cliff".

unless there is noise from birds or crickets. During November 2013 gusts exceeded 36 km/h on 22 days, with a maximum of 89 km/h[4].

MOECC should not accept the TransCanada conclusion that "the hourly sound levels represented in the (TransCanada) report are more common". The sound levels may represent those close to the lake during an unusually windy month but do not represent the ambient sound pressure level on Amherst Island.

4) Summary

This detailed response gives the reasons that the Honourable Glen Murray, Minister of the Environment and Climate Change, must reject the Director's two decisions:

- To forgo a full environmental review of the noise assessment of the Napanee Generating Station;
- To reject our request that there must be a full cumulative impact assessment of the sum total impact of the proposed Windlectric turbine project, the Lennox Generating System, the proposed TransCanada Napanee Gas Plant and the Lafarge Cement 2020 expansion.

September 2014

[4] http://climate.weather.gc.ca/climateData/dailydata_e.html?StationID=47267&timeframe=2&Year=2013&Month=11&cmdB1=Go#

Appendix

From Institute of Acoustics 2013

2.1.3 In 2001, a Swedish report specifically addressed large propagation distances over ground and over water. The model assumed a transition from spherical spreading to cylindrical spreading at a distance of 200 metres. This 200 metre break point was a function of the sound speed gradient in the atmosphere. In turn, the sound speed gradient depends upon the wind speed gradient and the temperature gradient. Both of these gradients, and therefore the sound speed gradient, vary with time. This Swedish propagation model, for distances larger than 200 metres, is written as:

$$L = L_s - 20\log(r) - 11 + 3 - \Delta L_a + 10\log\left(\frac{r}{200}\right)$$

2.1.4 L is the sound pressure level at the observer, L_s is the turbine sound power (e.g. 105 dB(A)), 11 is 10 log (4π), 3 is 3 dB(A) of ground reflection, ΔL_a is the integrated frequency dependent absorption coefficient, a function of r, and r is the distance from turbine hub to the observer. The second term on the right gives the spherical spreading and the final term corrects for cylindrical spreading beyond 200 metres.

2.2 Working Group Recommendation

2.2.1 The working group considers that current good practice for the calculation of noise propagation over large bodies of water (at least 700m in extent, i.e. propagation over the sea / lake / reservoir) is as follows:

- To assume a G=0 Hard Ground Correction
- To assume cylindrical spreading at 700m from the turbine, i.e.

$$L = Ls - 20Log(r) - 11 + 3 - \Delta La + 10\log\left(\frac{r}{700}\right)$$

2.2.2 L is the sound pressure level at the observer, Ls is the turbine sound power (e.g. 105 dB(A)), 11 is 10 log (4π), 3 is 3 dB(A) of ground reflection, ΔLa is the integrated frequency dependent absorption coefficient, a function of r, and r is the distance from turbine hub to the observer. The second term on the right gives the spherical spreading and the final term corrects for cylindrical spreading beyond 700 metres.

From Harrison, 2012:

"In 2001, a Swedish report specifically addressed larger distances both over ground and over water. The model assumed a transition from spherical spreading to cylindrical spreading at a distance of 200 metres. This 200 metre break point is a function of the sound speed gradient in the atmosphere. In turn, the sound speed gradient depends upon the wind speed gradient and the temperature gradient. Both of these gradients, and therefore the sound speed gradient, vary with time. This Swedish propagation model, for distances larger than 200 metres, is written as:

$$L = L_s - 20\,log(r) - 11 + 3 - \Delta L_a + 10log\left(\frac{r}{200}\right)$$

L is the sound pressure level at the observer, L_s is the turbine sound power (e.g. 105 dBA), 11 is 10 log (4π), 3 is 3 dBA of ground reflection, ΔL_a is the integrated frequency dependent absorption coefficient, a function of r, and r is the distance from turbine hub to the observer. The second term on the right gives the spherical spreading and the final term corrects for cylindrical spreading beyond 200 metres."

The modelling exercise was followed by Boué's validation. This extract from Harrison 2012 describes the significance of the measurements for the Swedish model:

"In a report for the Swedish Energy Agency - "Long-Range Sound Propagation over the Sea with Application to Wind Turbine Noise",

http://www.vindenergi.org/Vindforskrapporter/V-201_TRANS_webb.pdf

Boué investigated the Swedish propagation model by making sound propagation measurements over sea in the Kalmar Strait between Sweden and the island Öland in the Baltic Sea. The separation between source and receiver was 9.7 km. Measurements of average sound transmission loss showed agreement with the Swedish propagation model with a break between spherical and cylindrical spreading at 700 metres rather than the token 200 metres in the model. Furthermore, the measured TL(90), the transmission loss exceeded 90% of the time, was in agreement with the Swedish propagation model with the 200 metre break point. Therefore, Boué's measurements allow a reliable estimate of the sound pressure level as a function of distance over water from a turbine. Interestingly, Dr. Phillip Dickinson, Emeritus Professor of Acoustics at Massey University, has found the break point of 750 metres for turbine noise propagation over land. (See Sound, Noise Flicker, B. Rapley and H. Bakker, eds.; Atkinson and Rapley (2010), p. 175)"

The Institute of Acoustics Working Group has used the 700 metre break point in their recommendation. However, for 10% of the time atmospheric conditions will dictate that a break point of 200 metres should be used.