Exhibit AC15

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TECHNICAL REPORT

Title: Crowned Ridge Wind Sound Testing November 2021 Data Review and Assessment

Project: Crowned Ridge Wind, Docket EL19-003
Location: Watertown, SD
Prepared For: South Dakota Public Utilities Commission
Prepared By: David M. Hessler, P.E., INCE
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Attachments: **Appendix A** - Project Shutdown Listing

1.0 Introduction

The Crowned Ridge Wind Project (CRW) is required through the permit conditions imposed by the South Dakota Public Utilities Commission (SDPUC) to meet certain sound level limits at potentially sensitive receptors. Previous field surveys carried out by the Project's acoustical consulting firm, Epsilon Associates, have generally shown that the Project is meeting the required standards, including the survey carried out in October and November of 2020, which was intended to be the final operational survey of the completed project. However, an independent review of the data collected during this survey by Hessler Associates found that several overages occurred when the turbines were not operating at 100% electrical output (2300 kW) – a prescribed condition of the test protocol for that survey – and therefore not detected in the Epsilon data analysis. Subsequent investigation revealed that the cause of these noisy periods was apparently a buildup of ice or frost on the turbine blades, which caused them to generate significantly more noise than they otherwise would. As a result of this finding a mitigation plan was devised by CRW where winter ice operating mode (WIOM) software would be installed to automatically monitor for ice and shut down affected units to prevent a spike in noise. A facet of the mitigation plan was to retest the Project's sound emissions during similar winter conditions without limiting the evaluation to 100% power output in order to see if the problem persisted or not, should icing conditions occur. This test was carried out by Epsilon over a two week period in November of 2021 and the test results, indicating that the permit sound levels were being met at all test points, were submitted to the SDPUC on February 14, 2022.

Hessler Associates has been engaged by the staff of the SDPUC to independently evaluate the raw survey data from this survey and assess the validity of the study and its conclusions. This report summarizes the results of this independent data analysis.

Our independent analysis of the survey data indicates that the sound emissions from the project are, in fact, compliant with the noise limits contained in the permit conditions. Additionally, we find no faults or errors in Epsilon's final report on the survey and agree with its conclusions. In fact, Epsilon should be commended for the massive amount of time and effort that went into properly carrying out this lengthy field survey during difficult wintertime conditions.

1.1 Executive Summary

The Crowned Ridge Wind Project (CRW) is required through the permit conditions imposed by the South Dakota Public Utilities Commission (SDPUC) to meet certain sound level limits at potentially sensitive receptors; essentially, 45 dBA at non-participating residences and 50 dBA at participating residences. Previous field surveys carried out by the Project's acoustical consulting firm, Epsilon Associates, have generally shown that the Project is meeting the required standards, including the survey carried out in October and November of 2020, which was intended to be the final operational survey of the completed project. However, an independent review of the data collected during this survey by Hessler Associates found that several overages occurred when the turbines were not operating at 100% electrical output (2300 kW) – a prescribed condition of the test protocol for that survey – and therefore not detected in the Epsilon data analysis. Subsequent investigation revealed that the cause of these noisy periods was apparently a buildup of ice or frost on the turbine blades, which caused them to generate significantly more noise than they otherwise would. As a result of this finding a mitigation plan was devised by CRW where winter ice operating mode (WIOM) software would be installed to automatically monitor for ice and shut down affected units to prevent a spike in noise. A facet of the mitigation plan was to retest the Project's sound emissions during similar winter conditions without limiting the evaluation to 100% power output in order to see if the problem persisted or not, should icing conditions occur. This test was carried out by Epsilon over a two week period in November of 2021 and their final report was submitted to the SDPUC on February 14, 2022.

Hessler Associates has been engaged by the staff of the SDPUC to independently evaluate the raw survey data from this survey and assess the validity of the study and its conclusions. While the Epsilon analysis is purely numerical in nature; i.e. the raw data are sorted and evaluated based strictly on the valid conditions outlined in the test protocol, we have taken a graphical approach in order to visualize what is happening over the entire test period and during and around times of interest, such as when scheduled shut downs happened to occur during favorable wind conditions (low ground level wind speed) and near maximum power output. Attention was also paid to sound levels during potential icing conditions even if precipitation was observed, an exclusionary condition of the test protocol.

There were five test positions in this survey, designated as Locations 3A, 6, 7, 8 and 9, generally representing the nearest residences to the Project as determined from the predicted/modeled sound levels. The results of our analysis are summarized in the following table, which shows the observed Project-only sound levels during five periods when the wind speeds or potential icing conditions were generally conducive to the occurrence of maximum Project sound levels.

Table 1.1.1
Project-only Sound Levels at Locations 3A through 9
Derived from Shutdowns during Periods of Interest

	Observed Project-Only Sound Level, Leq (dBA)															
	Detail A		Detail B		Detail C		Detail D			Detail E			Detail F			
Shutdown	4	5	11	12	17	18	33	34	35	39	40	41	55	56	57	58
3A Limit 45	33	b	39[a]	40[a]	**40**	35[a]	b	b	b	c	c	c	c	d	d	d
6 Limit 45	d	b	36[a]	39[a]	**42[a]**	c	b	b	c	b	c	c	b	c	c	b
7 Limit 50	31[a]	c	**40**	39	35	37	b	b	b	39	c	c	b	d	d	d
8 Limit 45	29[a]	c	**41**	38	39	36	b	b	b	c	b	c	c	d	d	d
9 Limit 45	c	c	b	c	**46[e]**	b	b	b	b	c	c	c	c	d	d	d
Note a: On/Off differential < 4 dBA, value not definitive																
Note b: On/Off levels essentially equivalent, Project level indeterminate																
Note c: Off level higher than on, Project level indeterminate																
Note d: Survey not yet started or already concluded at this location, no data																
Note e: Project not audible in audio recording, value inconclusive																

It is evident from the table that the sound emissions from the Project are rarely discernable above the natural background level. In most cases, the sound level remained essentially the same when the turbines were temporarily shut down or was even higher during the outage then immediately before and after. Both of these circumstances imply that the Project-only sound level was well below the prevailing environmental sound level and contributed little or nothing to the total. The best conditions for detecting the Project generally occurred during detail periods B and C when the Project was consistently operating at full output but the ground level wind speeds and, therefore, the generation of interfering local background noise were minimal. The maximum calculated Project sound levels ranged from 40 to 42 dBA at Locations 3A through 8 and were all below the permissible limits of either 45 or 50 dBA.

At Position 9 the Project-only sound level could not be determined in all cases except for Shutdown 17 at 1:00 a.m. November 8. For at least an hour before this shutdown the total Leq sound level (both Project and background) was steady at 45 dBA (indicating compliance). During the shutdown the sound level dropped to an average of 38 dBA and then increased to around 49 dBA once the turbines were restarted. Mathematically, that ostensibly puts the Project-only sound level 1 dBA over the permit limit of 45 dBA at that Location; however, there is no apparent reason why the Project would be significantly louder after the shutdown than before since the wind and weather conditions were largely unchanged through this outage period. A review of the audio files recorded before, during and after this shutdown indicates only that a hissing, leaf rustle sound is present

whether the turbines are on or not. The rhythmic churning sound of wind turbines is not perceptible in the before or after recordings. Consequently, although the numbers suggest that the Project may have been generating a sound level of 46 dBA at this time, it is our view that the data are inconclusive and do not provide enough evidence to demonstrate a permit exceedance – particularly in light of the fact the Project was completely undetectable at this location during all the other shutdowns that were examined.

In addition to independently reviewing the raw field data, we have reviewed Epsilon's final report for the survey. We find no faults or errors with this report and agree with its findings. A general comparison of the fundamental results from both analyses is shown in Table 1.1.2.

Table 1.1.2
Comparison of Epsilon and Hessler Analysis Results

Location	Applicable Permit Limit, Leq (10 min), dBA	Range of Project-only Sound Levels Measured by Epsilon, dBA[a]	Maximum Observed Project-only Sound Level (Hessler), dBA
3A	45	28 to 44	40
6	45	32 to 42	42[b]
7	50	25 to 45	40
8	45	27 to 44	41
9	45	31 to 45	46[c]
Note a: Epsilon Associates, Sound Level Compliance Evaluation Report, 2/14/22, Table 8-1, p. 8-2			
Note b: On/Off differential < 4 dBA, value not definitive			
Note c: Project not audible in audio recording, value inconclusive			

In summary, we would conclude, based on the extensive analyses carried out by Epsilon and our own independent assessment of the raw field data, that the Crowned Ridge Wind Project is compliant with the noise limits contained in Condition 26 of the "Final Decision and Order Granting Permit to Construct Facility; Notice of Entry" issued by the South Dakota Public Utilities Commission.

2.0 Independent Assessment

The sound emissions from wind turbines at typical setback distances to residences are quite difficult to measure and quantify. This is because the natural environmental sound level during the windy conditions necessary for the project to operate are similar to and often higher than the project-only sound level. Consequently, it can be generally stated as a fact that the total observed sound level at any given location under virtually all wind and weather conditions is not the project sound level, but rather is a combination of the project sound level and the natural sound level that

would otherwise exist. During high wind conditions the project component of the total sound level essentially becomes negligible and is completely drowned out by wind-induced sounds, either actual, such as trees or crops rustling, or artificial, as in microphone distortion from wind.

In an effort to overcome this difficulty, the test procedure/permit language specifically includes the use of multiple, short-duration project shutdowns to enable the measurement of the total sound level (project + background) and the background level alone within a few minutes of each other so that the wind and background noise conditions are held reasonably constant. The project-only sound level, which is the quantity subject to the regulatory limits, can then be derived by logarithmically subtracting the background level from the total level with the project on. However, even this ostensibly simple approach doesn't always yield a valid, or any, answer because it only works when the differential between the on and off levels is significant, or at least about 3 to 4 dB. In practice, such a large signal (project sound) to noise (background noise) ratio is rarely seen because the project sound level is intentionally designed to be low at sensitive receptors while the natural sound level increases essentially indefinitely with wind speed. When the signal to noise differential is lower than about 4 dB a technically valid project-only sound level cannot be calculated. Even though all units within 1.75 miles of the measurement locations were shut down over 50 times during this two-week survey, there were only a handful on instances when the sound level actually decreased by a significant amount while the turbines were off. In most cases there was no measurable change, the sound level was higher during the shutdown than during the operational periods immediately before or after, or the winds were too light for the project operate anywhere near full output.

While the Epsilon analysis is purely numerical in nature; i.e. the raw data are sorted and evaluated based strictly on the valid conditions outlined in the test protocol, we have taken a graphical approach in order to visualize what is happening over the entire test period and during and around times of interest, such as when scheduled shut downs happened to occur during favorable wind conditions (low ground level wind speed) and near maximum power output.

The graphics discussed below show, for each position, the measured average (Leq) and residual (L90) sound levels, the electrical output of the nearest turbine and the wind speeds at ground level and at hub height. The Project noise limits are expressed in terms of the 10 minute average level, or Leq(10 min). The L90 level, which tends to filter out sporadic contaminating noises, is plotted largely for informational purposes.

The first figure in each case shows the entire survey period and the following six plots enlarge the periods when the project was operating during a period of potential icing (Detail A) or generally operating at or near full power during shutdowns. It can be seen in the overall plots for each position that the total sound level (background + Project) is below the permissible limit much of the time, often when the turbines are operating in low to moderate wind conditions. Analyses of the shutdowns or specific project sound levels during these times are moot, but numerous in the Epsilon report as a function of the test protocol parameters. This assessment generally focuses on times when operation at or near full output is occurring, the ground level wind speed was low

(minimizing background interference) and/or the sound level is ostensibly above the applicable limit for that position. As listed in **Appendix A**, all units within 1.75 miles of the measurement locations were deliberately shutdown 58 times during the sound survey, largely on a regular schedule irrespective of turbine output.

There were five test positions in this survey, designated as Locations 3A, 6, 7, 8 and 9, generally representing the nearest residences to the Project as determined from the predicted/modeled sound levels.

2.1 Location 3A – Non-Participating Residence, 45 dBA Permit Limit

The overall results for Position 3A, at a non-participating residence near the center of the project, are shown below, along with the shaded regions corresponding to Details A through F.

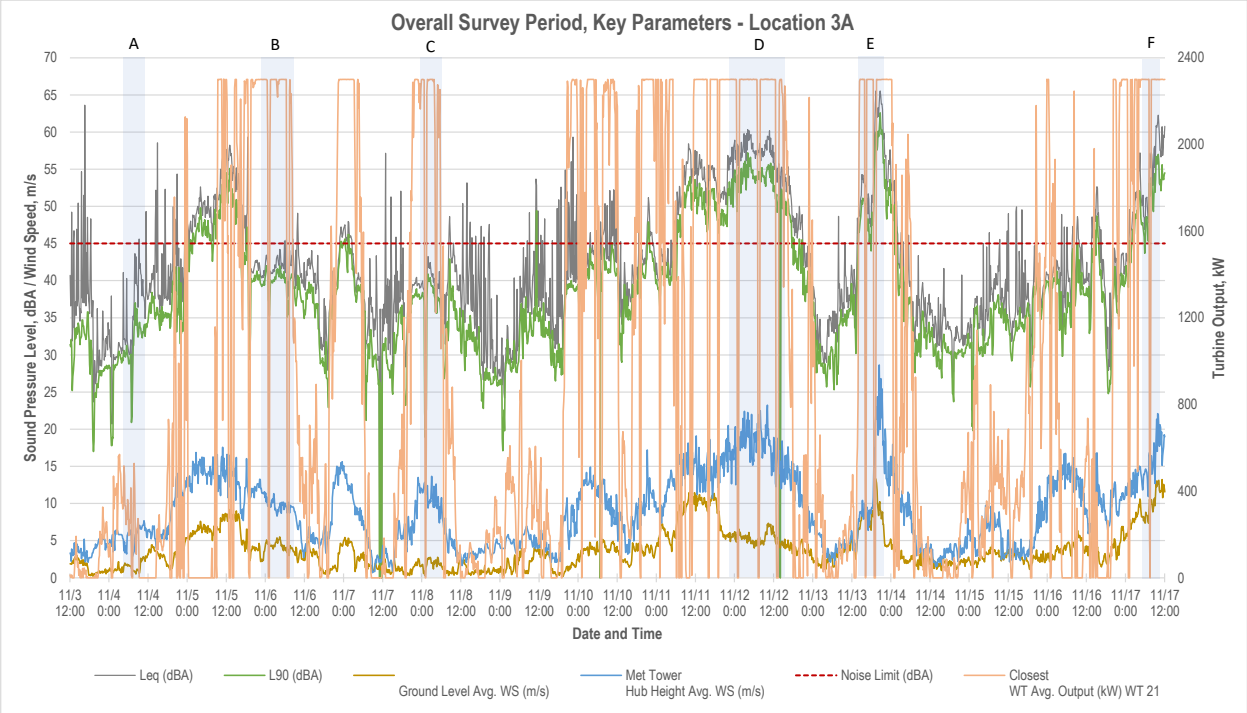

Figure 2.1.1

Detail A, enlarged below, shows a period when potential icing may have occurred; i.e. the weather conditions were generally favorable for freezing mist or sleet – but it is not known if ice actually formed on the turbine blades.

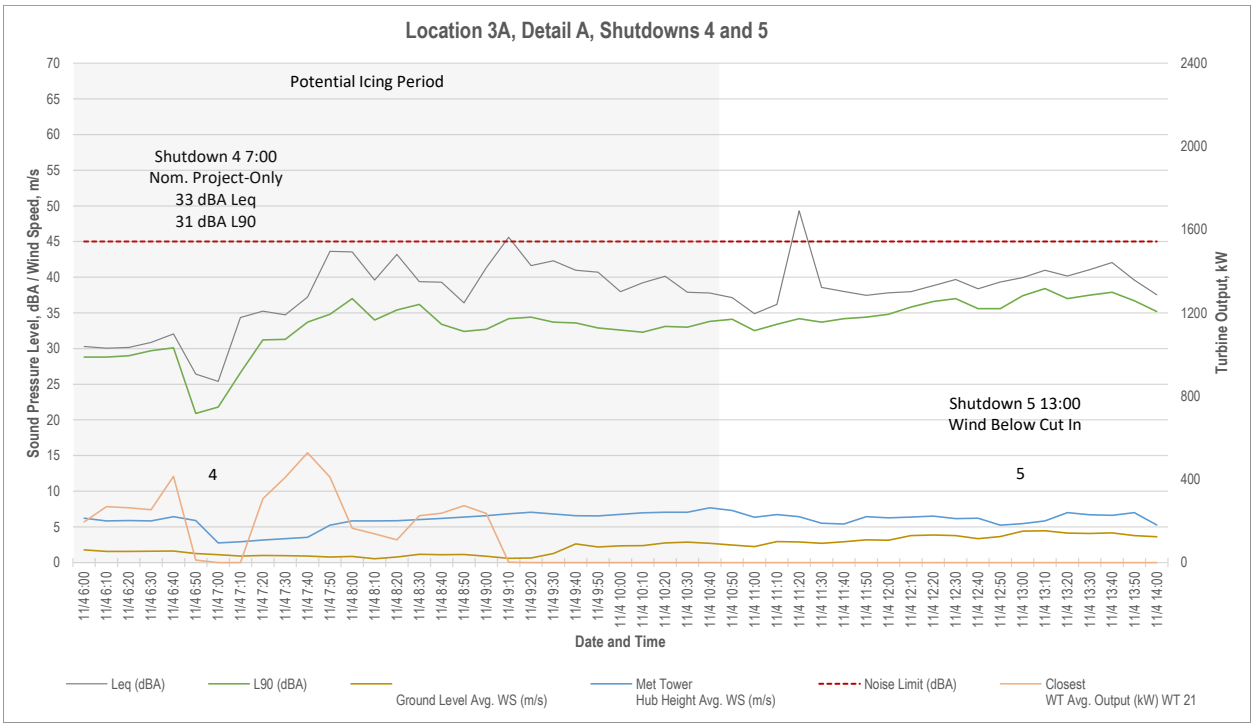

Figure 2.1.2

Shutdown 4 at 7:00 a.m. on 11/4/21 is of interest because it occurred during these particular weather conditions. The definite dip in the sound levels during this shutdown indicate that Project noise was prominent relative to the background level at the time. If the Project-off level during the outage is subtracted from the average before and after sound levels, a very low Project-only sound level of 33 dBA (Leq) can be surmised. Clearly, this sound level is well within the permissible 45 dBA limit, but that is not particularly surprising given the fact that the wind speeds were just barely sufficient to cause the rotors to begin turning. The Leq sound levels after this shutdown, increase up to, but not over, the 45 dBA limit. At 9:10 a.m. the nearest unit (WT21) shut down at the same time as the sound level reached its maximum. While this appears to be a possible instance of the winter ice operating mode (WIOM) at work, since the hub height wind speed did not change before and after this shut off, further research indicates that this shutdown was coincidental (for maintenance reasons). Additionally, the noise spikes up to 45 dBA were identified from audio recordings as local contamination.

Detail B (Figure 2.1.3) shows a period when the Project was operating at full power and shutdowns occurred when surface winds were fairly light (around 5 m/s) minimizing background contamination. Although ostensibly promising conditions, the total sound level only decreases by about 2 or 3 dBA during the shutdowns, which means that, while the Project's sound emissions were a significant component of the total, they were not dominant. This small on/off differential means that a definitive calculation cannot be made of the Project-only contribution, but it appears to have been in the 39 to 40 dBA range – indicating compliance with the permit conditions.

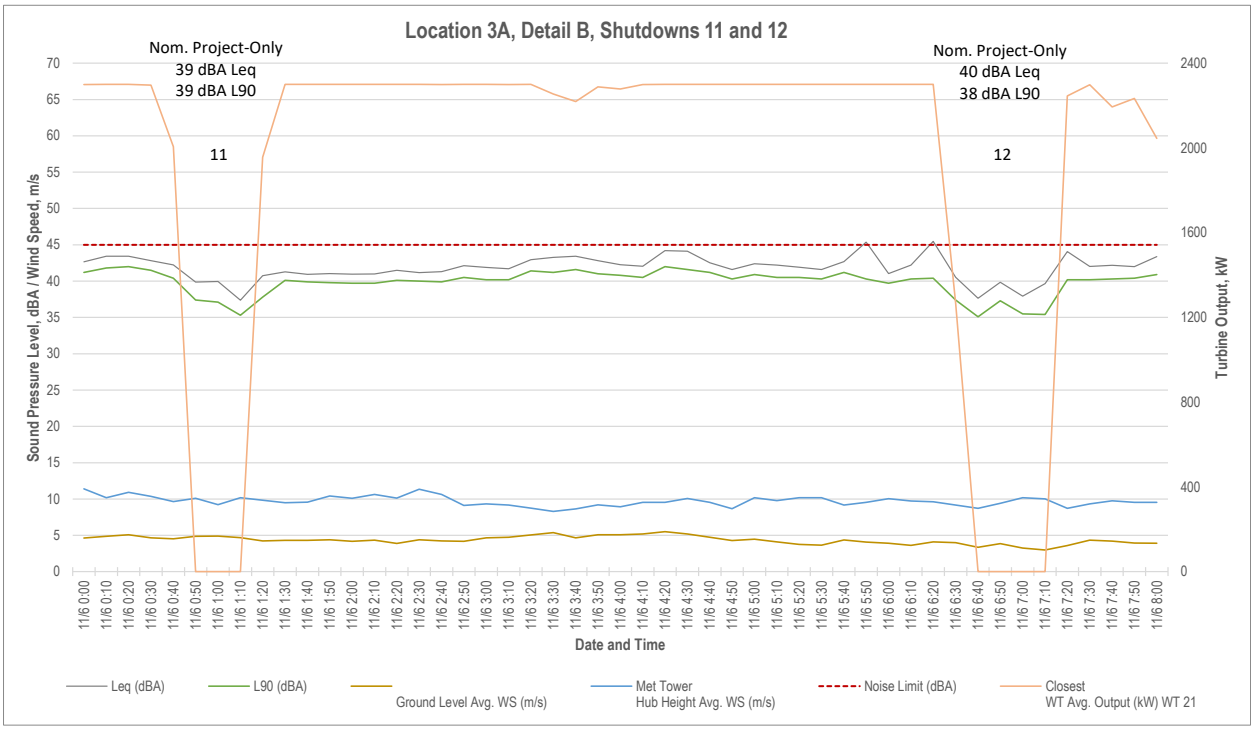
Location 3A, Detail B, Shutdowns 11 and 12
Nom. Project-Only
39 dBA Leq
39 dBA L90
11
Nom. Project-Only
40 dBA Leq
38 dBA L90
12
Sound Pressure Level, dBA / Wind Speed, m/s
Turbine Output, kW
Date and Time
Leq (dBA)
L90 (dBA)
Ground Level Avg. WS (m/s)
Met Tower
Hub Height Avg. WS (m/s)
Noise Limit (dBA)
Closest
WT Avg. Output (kW) WT 21

Figure 2.1.3

Detail C (Figure 2.1.4) shows a similar instance when a shutdown (17) occurred during full power operation and very low ground level wind conditions. In this case, the change in the on/off sound levels is much more pronounced and the Project-only sound level can be definitively calculated at 40 dBA (Leq). During the next shutdown (18) the hub height winds had diminished so that the Project was only operating at about 50% power and the on/off differential is hardly distinguishable. In fact, the Project level is almost too low to calculate, but appears to be around 35 dBA.

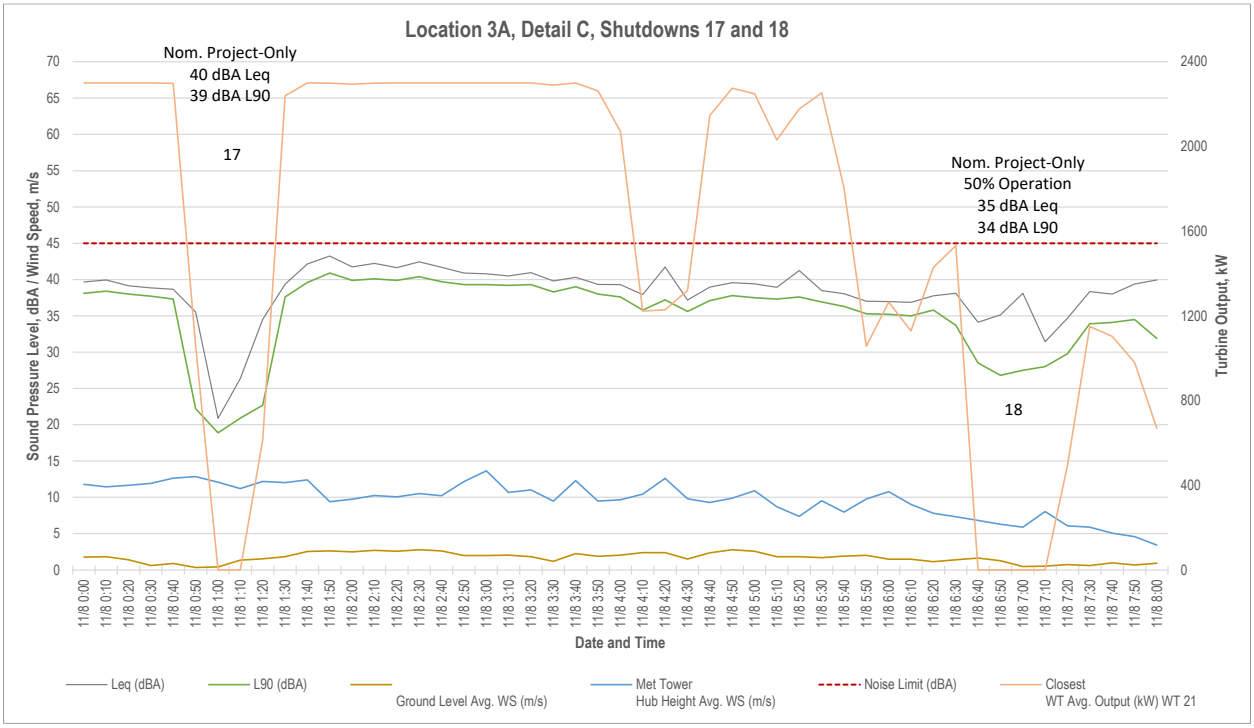

Figure 2.1.4

The time period shown in Detail D (Figure 2.1.5) was selected because the Project was operating steadily at full load while the ground level wind speed was consistently low through a number of shutdowns. In addition, the total sound level was significantly above the permissible limit and weather conditions indicated that icing was a possibility. Precipitation was observed during some of the shutdowns around this time. The plot shows that background sounds like rainfall or tree tops blowing were the likely reasons the Leq sound level hovered in the 55 to 60 dBA range because the sound level was virtually unaffected by any of the shutdowns that occurred during this time period. During Shutdown 35 after the precipitation ended the Leq sound level during the shutdown was equivalent to the average of the before and after levels. In essence, the Project was undetectable during this period and was not responsible for the sound levels well in excess of the permissible 45 dBA limit.

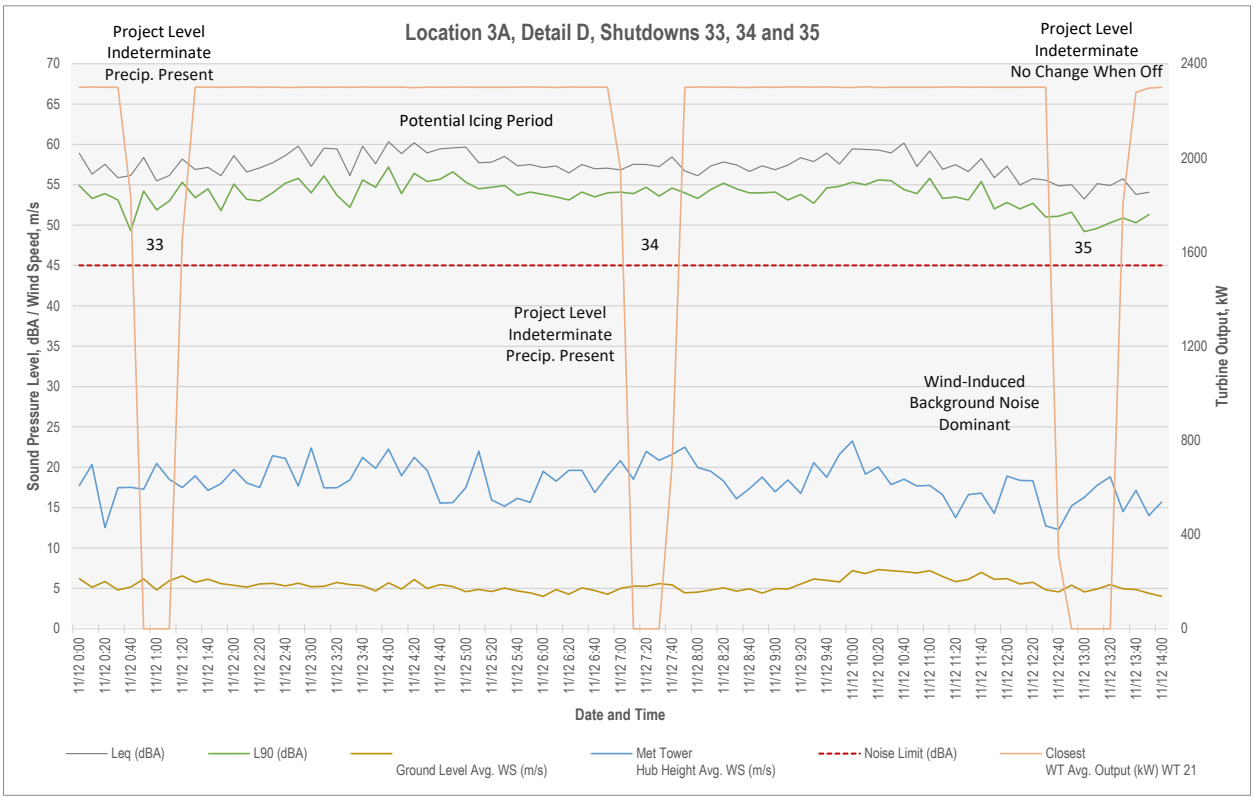

Figure 2.1.5

Detail E (Figure 2.1.6) shows a period that was potentially affected by icing and two shutdowns that happened during full power operation. Shutdown 39, squarely in the period of possible icing, occurred during fairly unusual conditions when the hub height wind speed was essentially equivalent to the ground level wind speed at around 4 to 5 m/s. Because the rotor was just barely turning no Project sound was detectable during this outage and, in fact, the Leq sound level was higher during the shutdown then before or after. Between that shutdown and the next both the wind speeds and sound levels increase in parallel until the Leq sound level is about 10 dBA above the permissible limit. While this appears to be Project-related and possibly due to icing, Shutdown 40, right at the end of the potential icing period, shows that Project noise was only an insignificant and probably non-contributing component of the total sound level, since the total sound is not affected in any way by the shutdown. Again, the Leq sound level is actually higher during the shutdown than before or after. The third shutdown in this detail (41) occurred during generally windy conditions (GL wind > 10 m/s) where wind-induced natural background sounds were dominant. For the third time, the sound level during the outage was higher than when the Project was operating. In general, this detail shows that the elevated sound levels, well above the permissible limit, were not attributable to the Project.

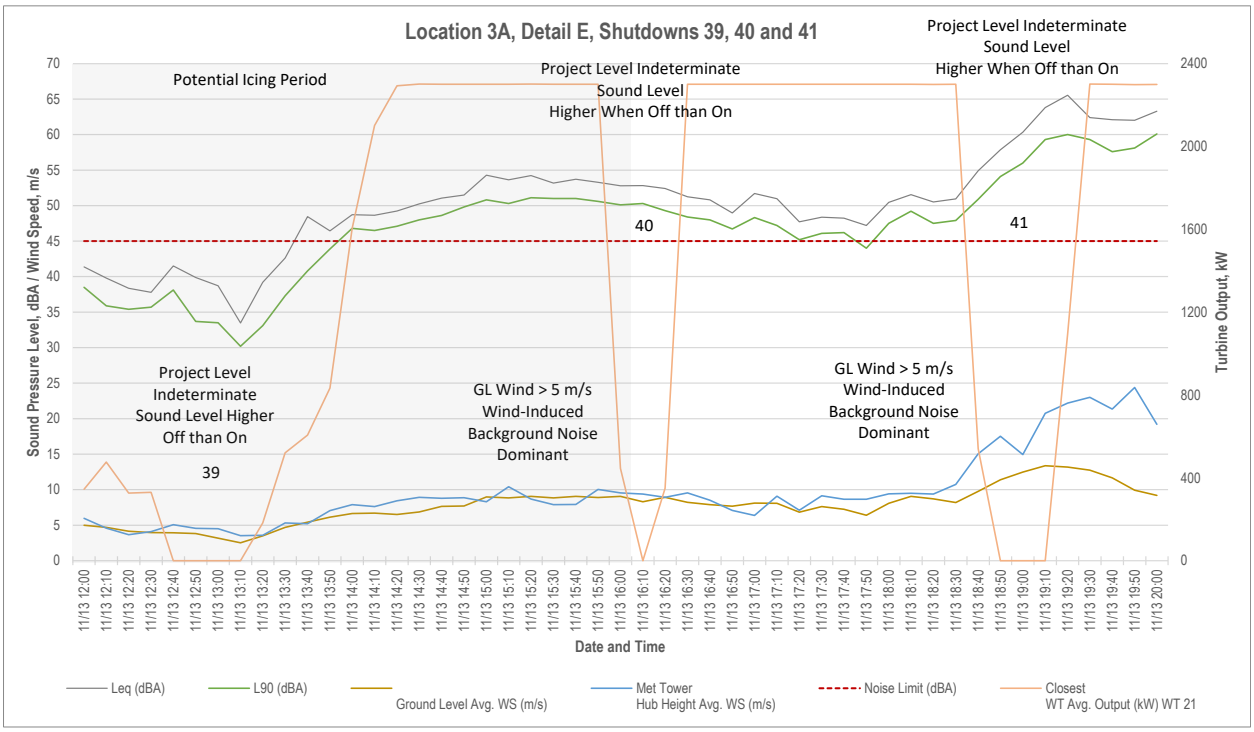

Figure 2.1.6

Detail F (Figure 2.1.7) shows the same situation. During Shutdown 55 high winds were driving the total sound level, since there was no decrease whatsoever when the Project, at full power, was temporarily shut off.

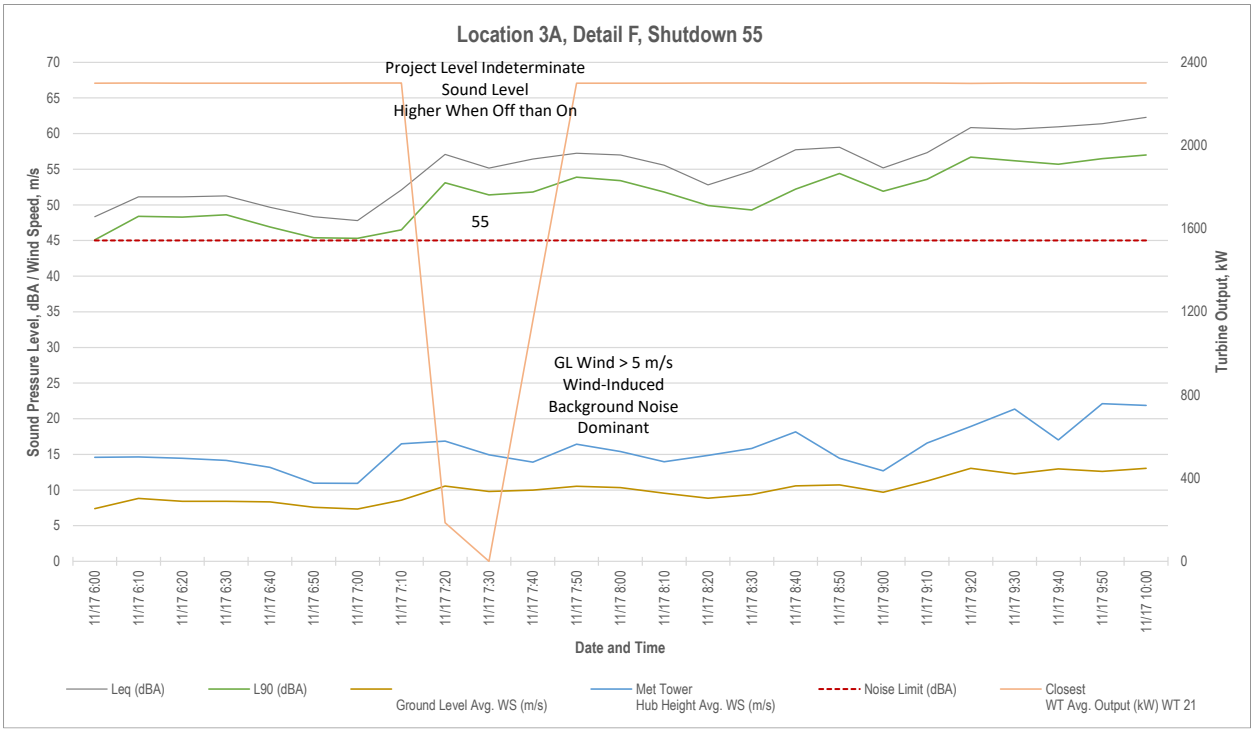

Figure 2.1.7

2.2 Location 6 – Non-Participating Residence, 45 dBA Permit Limit

The overall results for Location 6 are plotted below.

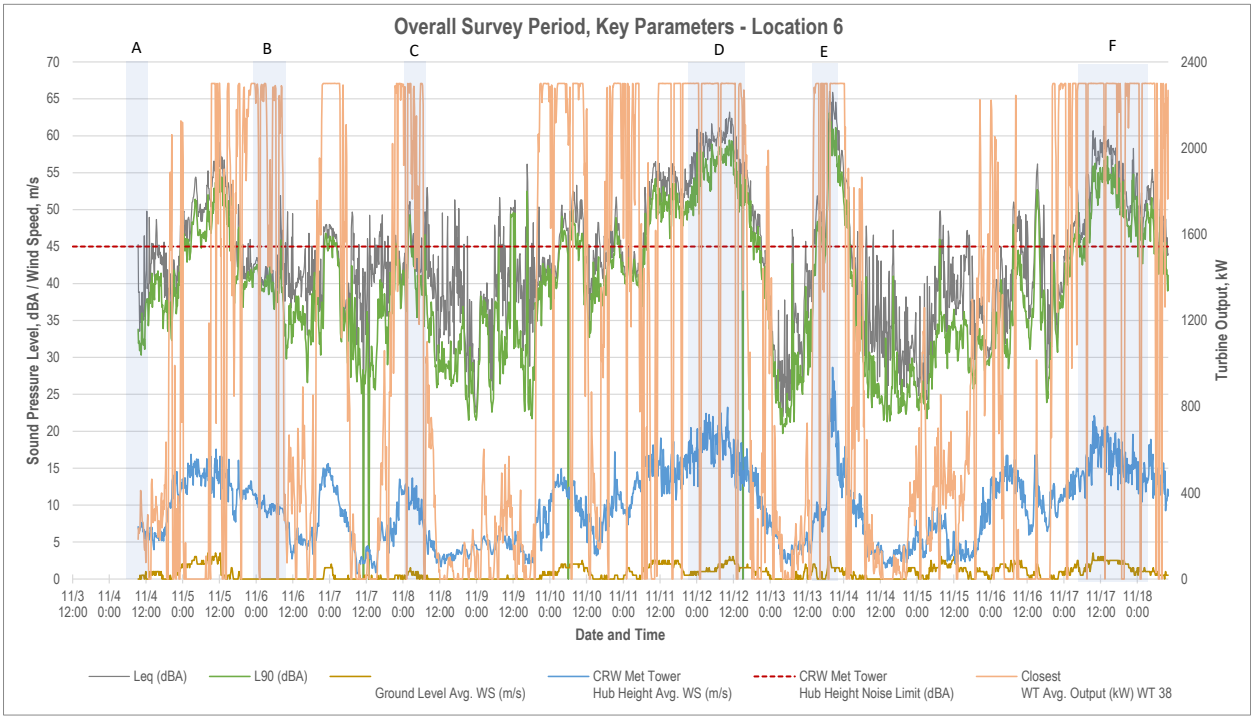

Figure 2.2.1

This chart is generally remarkable in that the average ground level wind speed never exceeds the validity threshold of 5 m/s. This is apparently due to the presence of wind-break vegetation around the test position and the proximity of the house itself. Epsilon rightly added the ground level wind speed measured at Location 3A to the Location 6 analyses to give a more realistic idea of the actual wind speed at microphone height. In theory, this sheltered measurement position should have minimized local contamination from wind-induced noise and allowed the meter to be more sensitive to Project's sound emissions, but a review of some audio files suggests that while the microphone itself might have been protected from high winds, rustling trees where still the predominant feature of the local environmental sound level.

Detail A (Figure 2.2.2) shows the first period of possible icing, but the survey was not started at this position until after Shutdown 4 (11/4 at 7:00 a.m. during the potential icing period) had occurred. Shutdown 5 was implemented during low wind conditions with the turbines barely turning so no on/off differential was detectable.

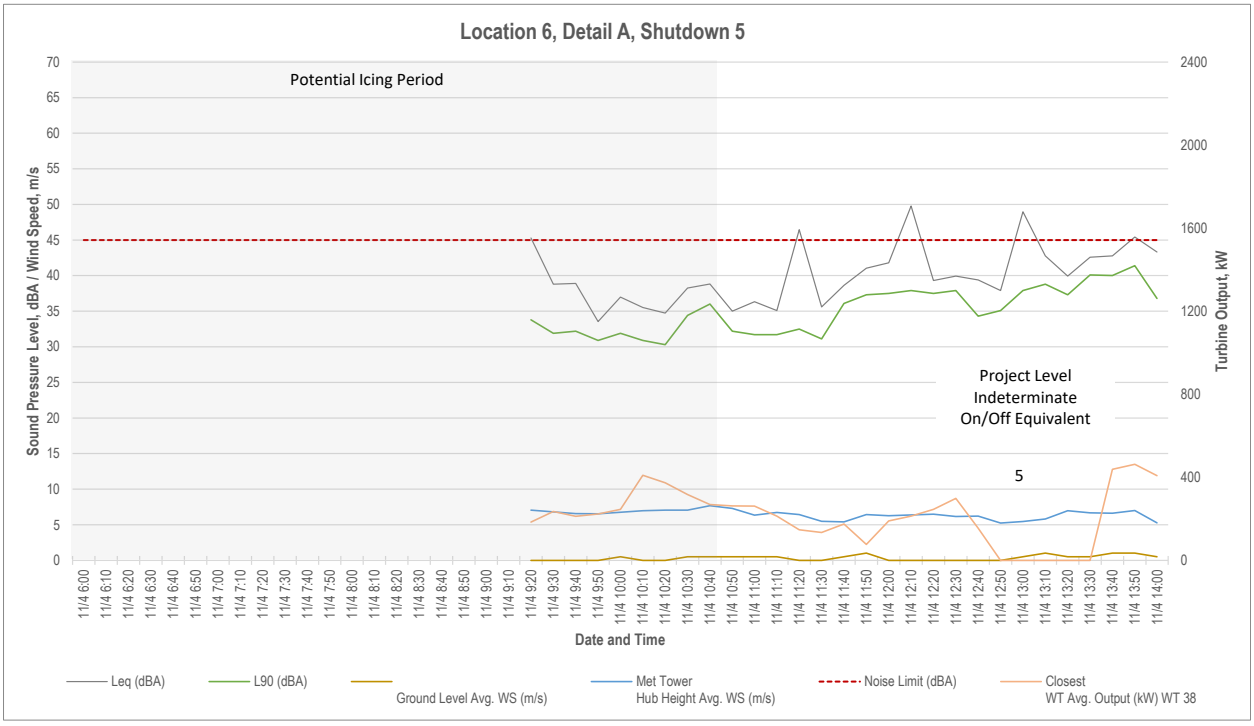

Figure 2.2.2

Detail B (Figure 2.2.3) shows two shutdowns during essentially full power operation. It can be seen graphically from the plot that the sound level appears to be totally unaffected by the two outages – meaning that Project noise was not a significant component of the total sound level. From a mathematical perspective, the average of the Leq sound levels before and after both shutdowns was about 2 dBA higher than the average level with the turbines off. This differential is technically inadequate to make a valid subtraction and one would say the Project was masked by background noise, but the theoretical Project-only sound levels appear to have been about 36 to 39 dBA during these shutdowns. These numbers are not definitive and represent a conservative measure of the Project sound level because the actual level could be, and may well be, considerably lower. At worst then, these data suggest that the Project is at least 6 dBA below the permissible 45 dBA limit at this position.

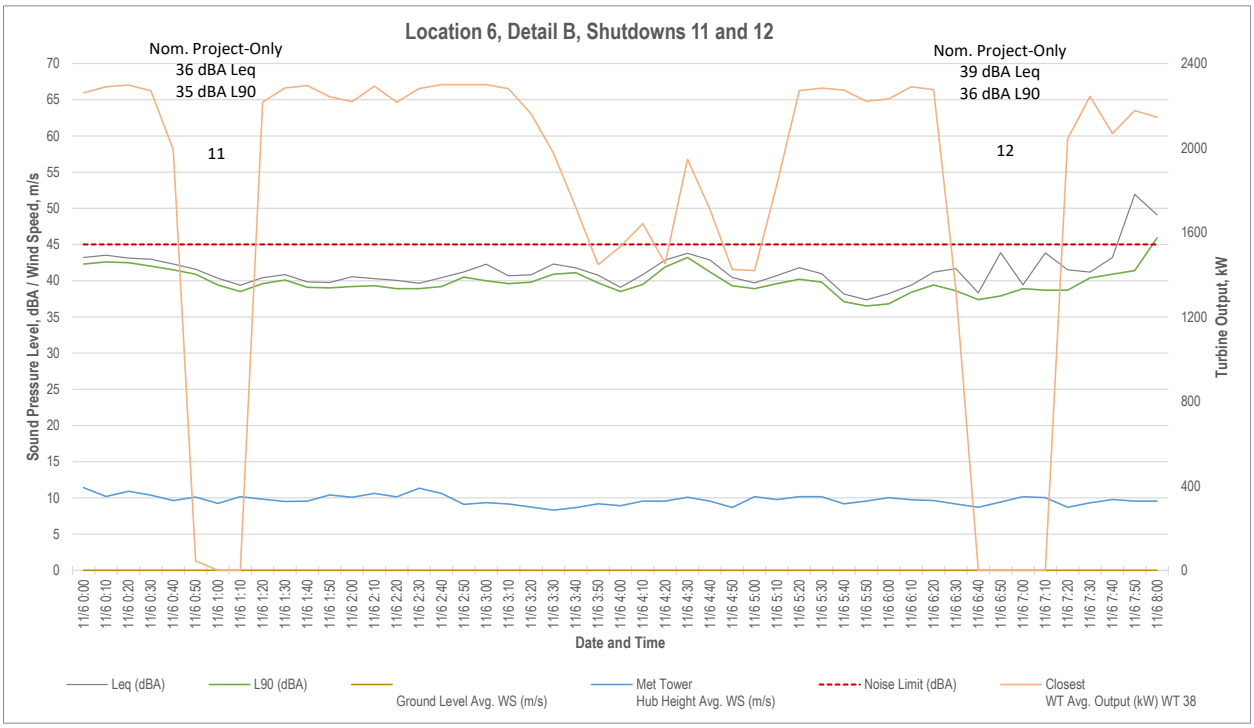

Figure 2.2.3

A similar situation is shown in Detail C (Figure 2.2.4). During Shutdown 17 there is no apparent dip in sound levels when the nearest turbines are temporarily taken off line, but the mathematical difference is about 3 dBA. This is still too small to make a definitive subtraction and determine the Project-only sound level, but nominally suggests a Project level of 42 dBA (Leq). However, a more likely explanation is that the background level simply increased just after the shutdown for reasons having nothing to do with the Project leading to the apparent 3 dBA on/off differential. Note how the Leq sound level just prior to the shutdown is roughly 43 dBA but is about 49 dBA just after. The Project was operating similarly at full power during both of these instances, so there's no cause-and-effect relationship that would point to the Project as suddenly being responsible for the elevated sound levels just after the shutdown. The apparent Project level of 42 dBA is very generous and more likely a mathematical construct rather than a true indication of the Project sound level.

During the next shutdown (18) the sound level is higher during the outage than just before when the nearest turbine was running at full power. This sort of behavior was observed in all the remaining shutdowns looked at in Details D through F (shown below), which is a strong indication that the Project sound level is largely undetectable at this location and is most likely below the highly conservative calculations just discussed suggesting levels in the 36 to 42 dBA range.

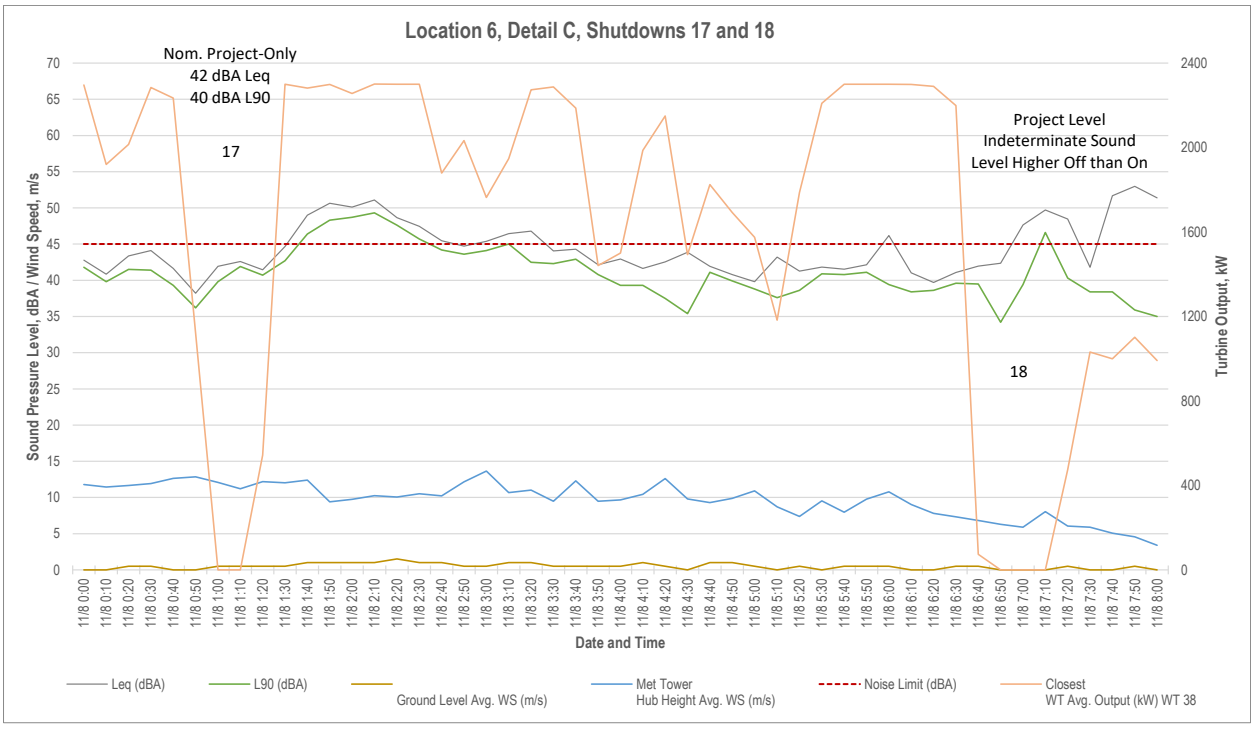

Figure 2.2.4

Detail D (Figure 2.2.5) shows three shutdowns during a period of full load operation and possible icing conditions – and very high hub height wind speeds. Because the total sound levels were unaffected by the shutdowns, natural background noise generated by the wind was clearly dominant.

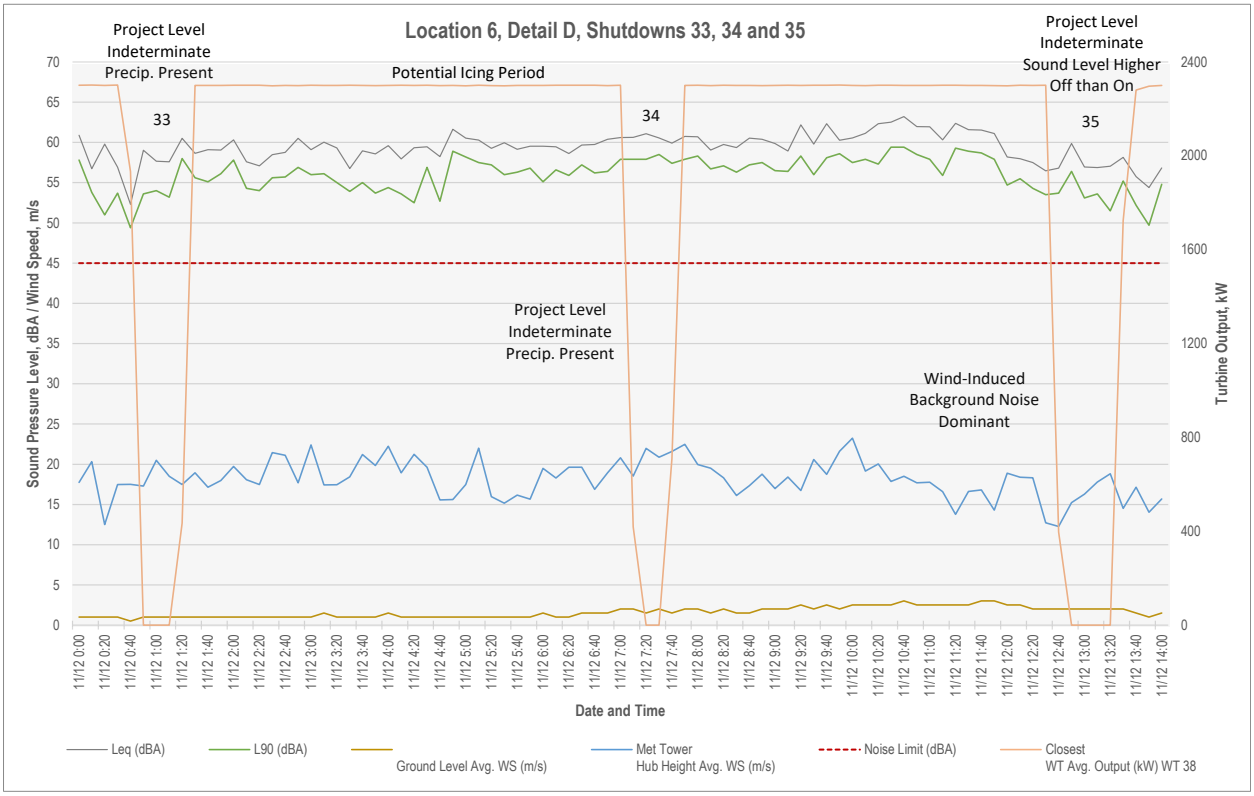

Figure 2.2.5

The three shutdowns in Detail E (Figure 2.2.6) also show no change in sound level when the turbines in the area were taken out of service, or the sound level is higher during the outage than just before and after. The substantial and continuous increase in sound levels through Shutdown 41 is clearly due to the increasing wind speed at hub height and the removal of Project noise has no effect on the total level – meaning it must be well below the observed sound levels.

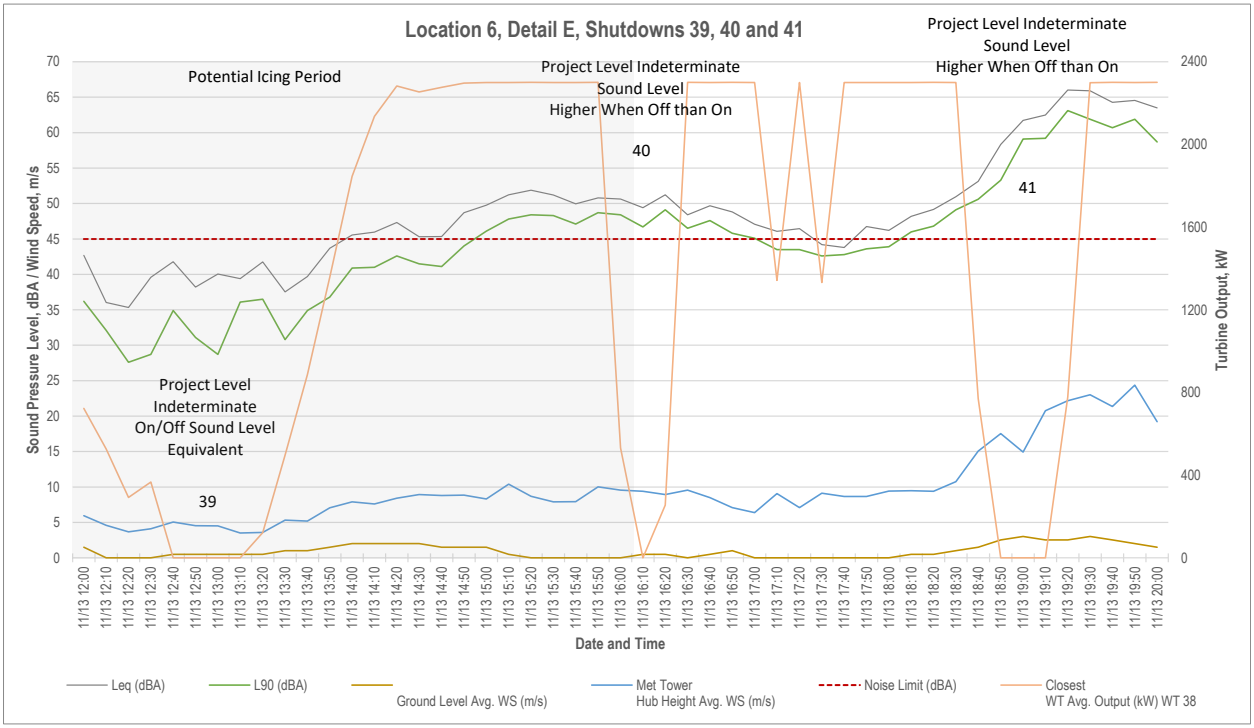

Figure 2.2.6

Detail F (Figure 2.2.7) shows a number of shutdowns from full power operation that were recorded only at this location after the other positions had been closed out. In all cases, the sound level during the outage was either equivalent to or higher than the average sound level before and after – meaning that the Project sound level was indeterminate. During the very last shutdown (58) a mild dip in sound level roughly coincides with the outage, but a review of the audio recording before, during and after this shutdown demonstrate that the roaring wind in bare trees was all that was audible.

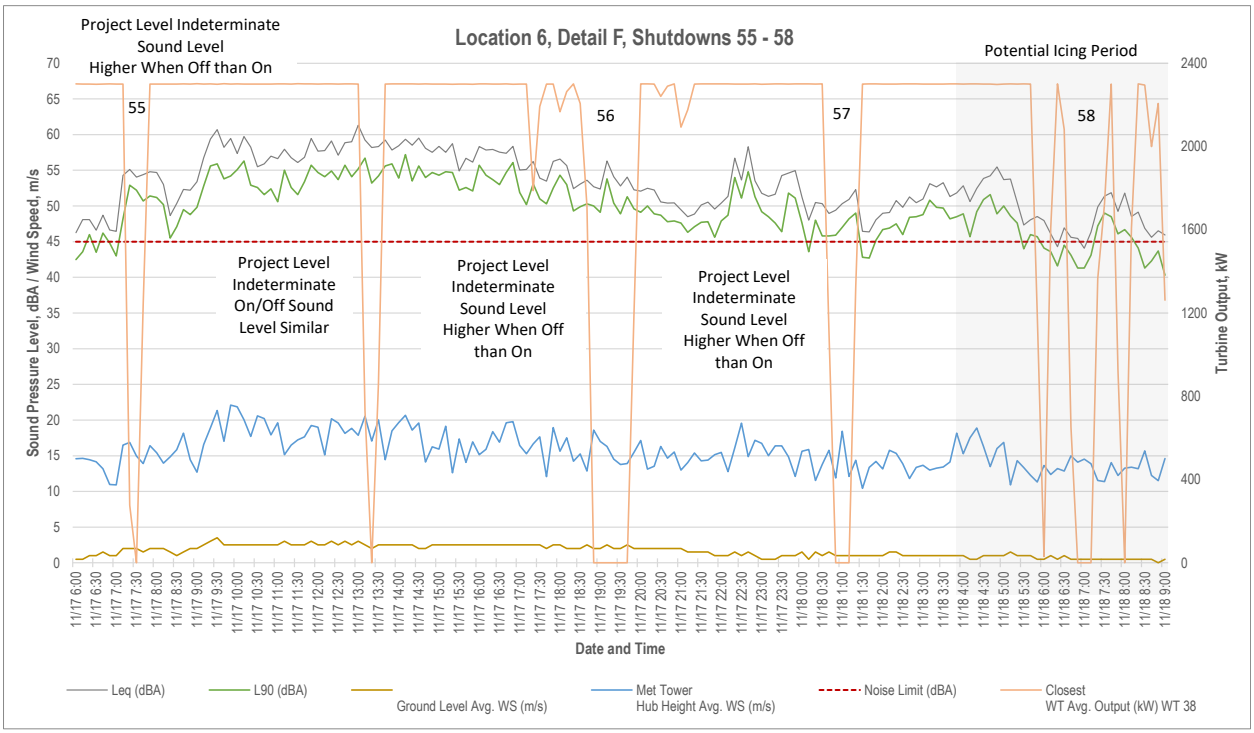

Figure 2.2.7

2.3 Location 7 – Participating Residence, 50 dBA Permit Limit

The overall results for Location 7 are plotted below.

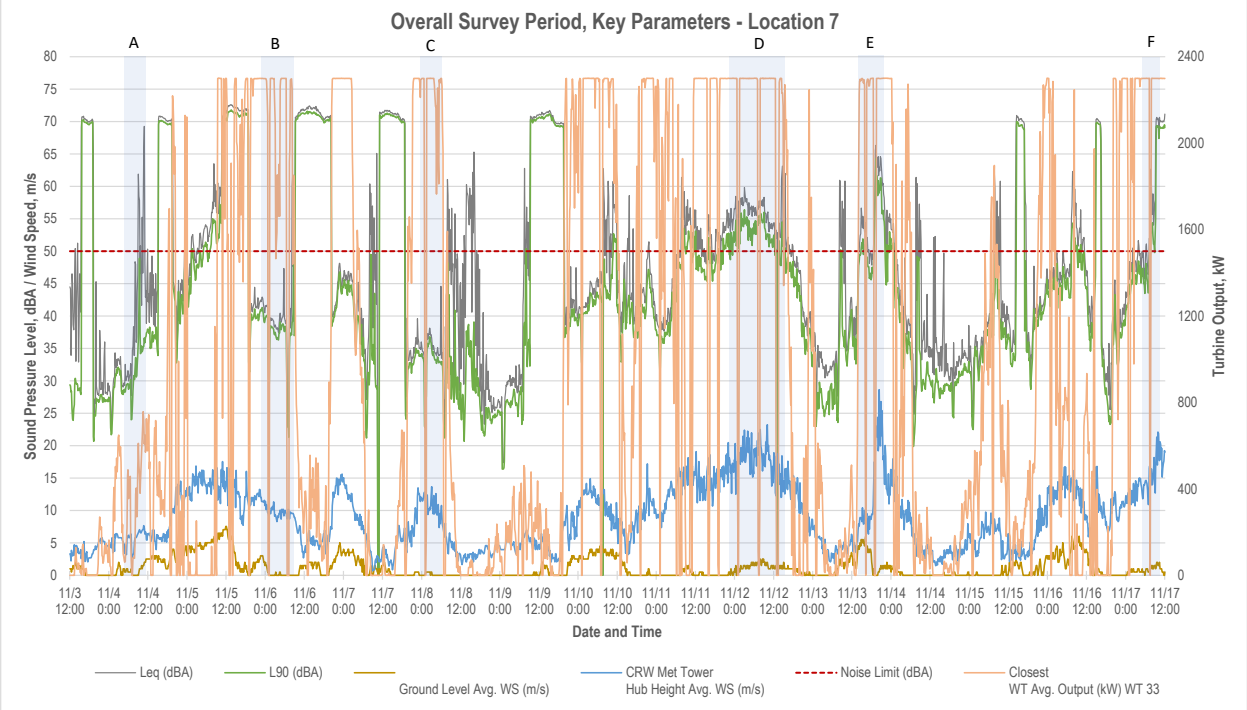

Figure 2.3.1

Detail A (Figure 2.3.2) shows the first period of potential icing. There is a small dip in the sound levels during Shutdown 4 showing that Project noise was a significant component of the total sound level, which at the time was extremely low. The differential is too small to make definitive calculation, but the nominal Project level (during very low power operation) looks like it was about 31 dBA. After this rather inconsequential shutdown the Leq sound level increases vaguely in parallel to the nearest turbine's power output with three successive peaks, each louder than the last, and greatly exceeding the 50 dBA limit for this location. On the surface this appears to be icing noise but a review of the audio files during this period shows that all three of the Leq peaks can be attributed to local farming activity, passing vehicles, and other local noises. In some cases, the Project may be faintly audible in the distant background during otherwise quiet moments but it is clear that the Project did not drive the peaks appearing in this plot.

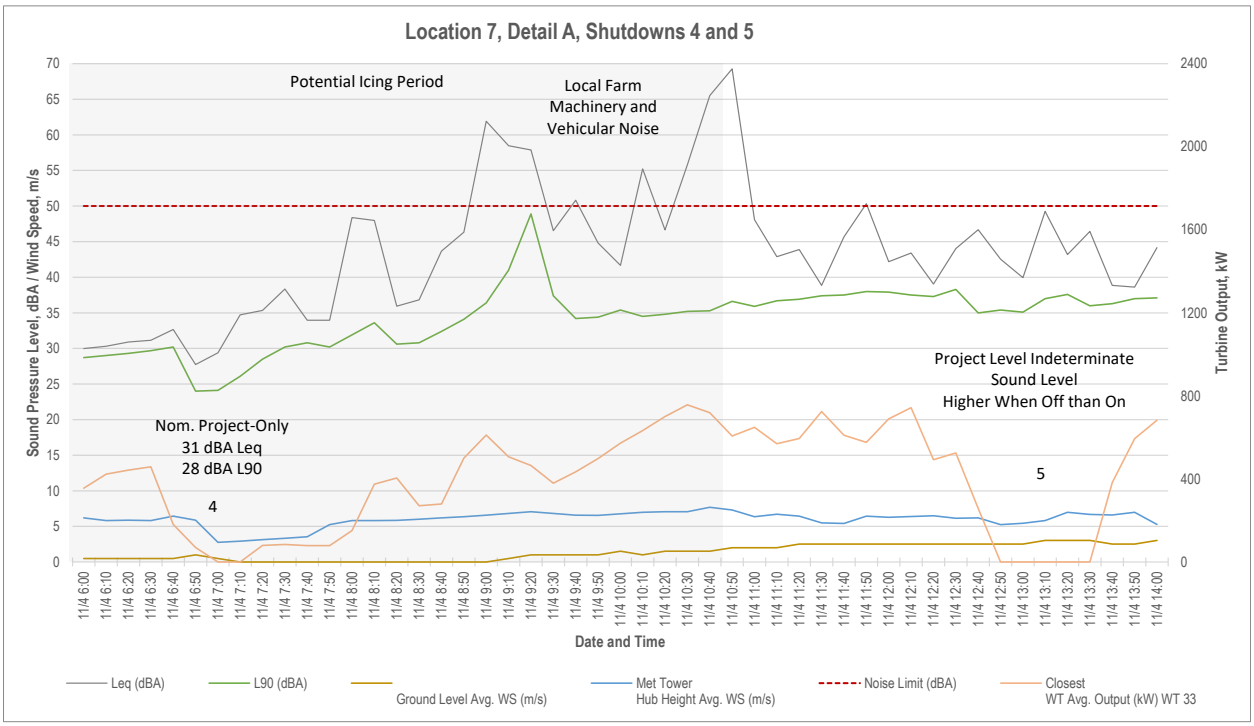

Figure 2.3.2

During the Detail B time period (Figure 2.3.3) ideal conditions existed to quantify the Project sound level. Levels of 39 and 40 dBA can be confidently deduced from the two shutdowns during full power operation.

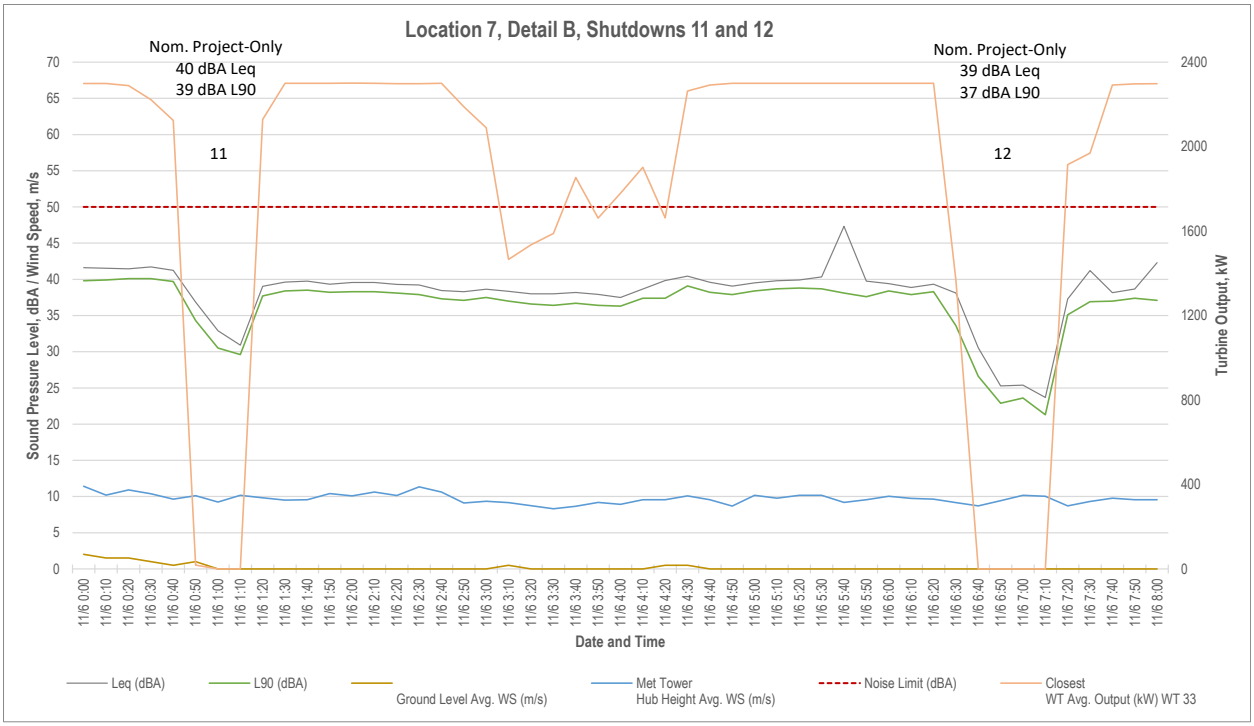

Figure 2.3.3

Similar conditions existed during the first part of the Detail C period (Figure 2.3.4). In this case, a lower Project-only sound level of 35 dBA was observed during full power operation. Differing atmospheric sound propagation conditions from those two days earlier on 11/6 (Detail B) are the likely the reason. A Project sound level of 37 dBA can be calculated from Shutdown 18 when the turbines were only operating at about 50% load. These varying, but reliable, values for the Project sound level in Details B and C illustrate the general reality that wind turbine sound level are highly variable with fluctuating wind and weather conditions and generally match model predictions only when averaged over a significant period of time.

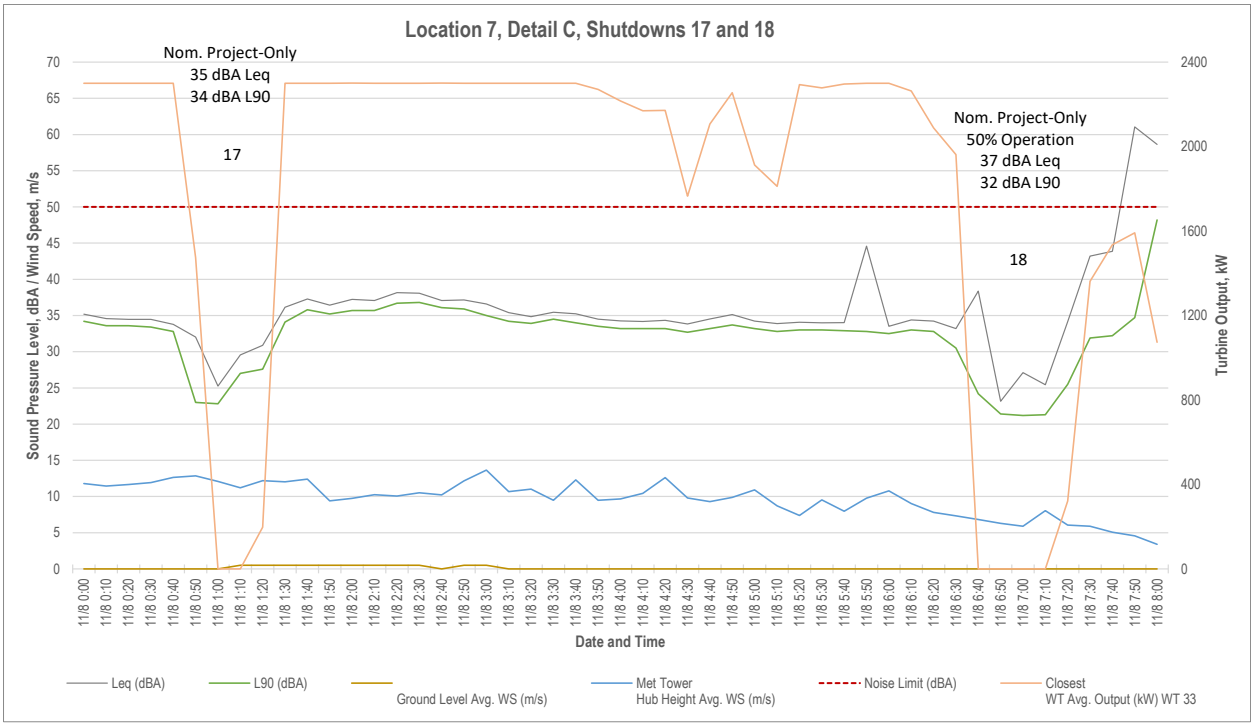

Figure 2.3.4

Masking noise from precipitation and wind-induced sounds generally drowned out the Project during the Detail D period (Figure 2.3.5). All three of the shutdowns made no observable impact on the overall sound level.

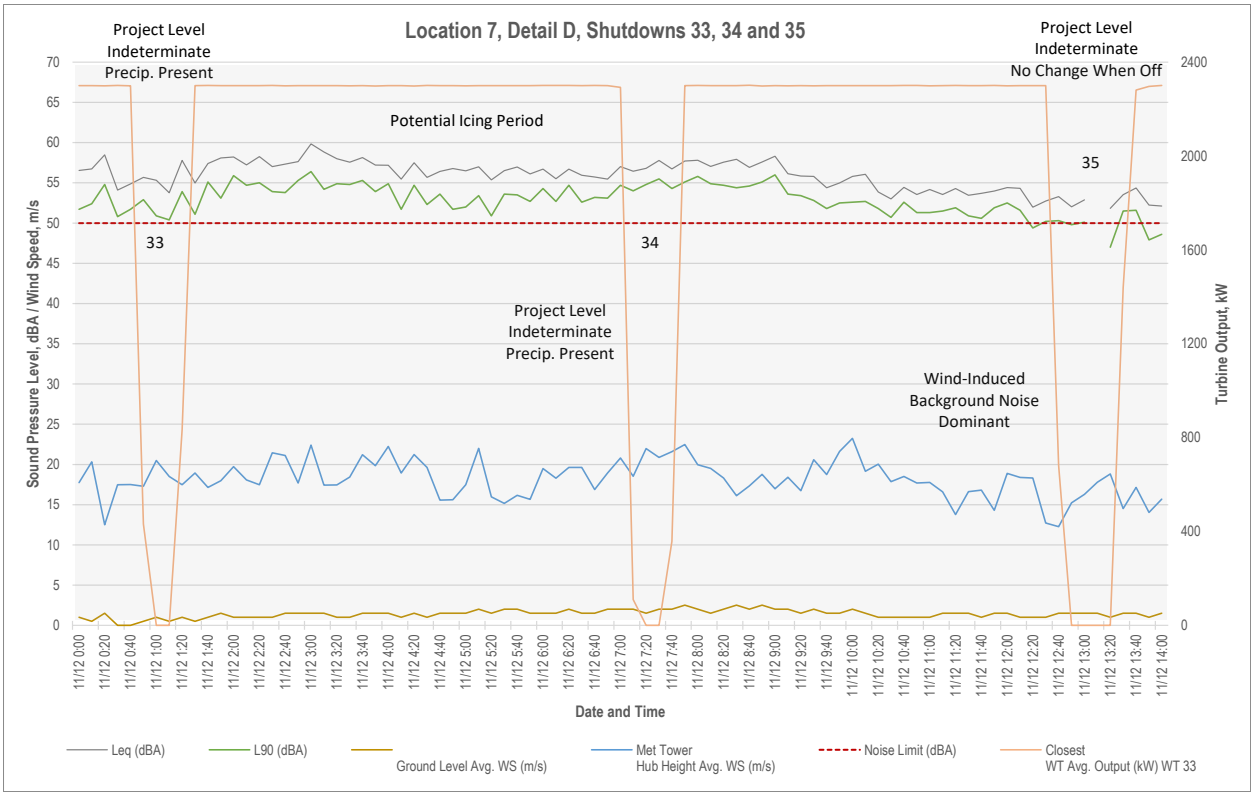

Figure 2.3.5

During the first shutdown in Detail E (Figure 2.3.6) a Project sound level of 39 dBA can be deduced. While the increase in the general sound level that followed this shutdown during a period of potential icing suggests possible icing noise, the next shutdown (40) shows that Project noise is not driving the total sound level at all. The shutdown from full power had no effect on the Leq sound level, which was actually somewhat higher during the outage than before or after. Consequently, it appears that icing did not occur and that the sound level was driven by background noise during this period. The audio recording during the peak at 14:50 was distorted, possibly from wind on the microphone (pseudo noise), which could be another reason for the elevated sound levels between Shutdowns 39 and 40.

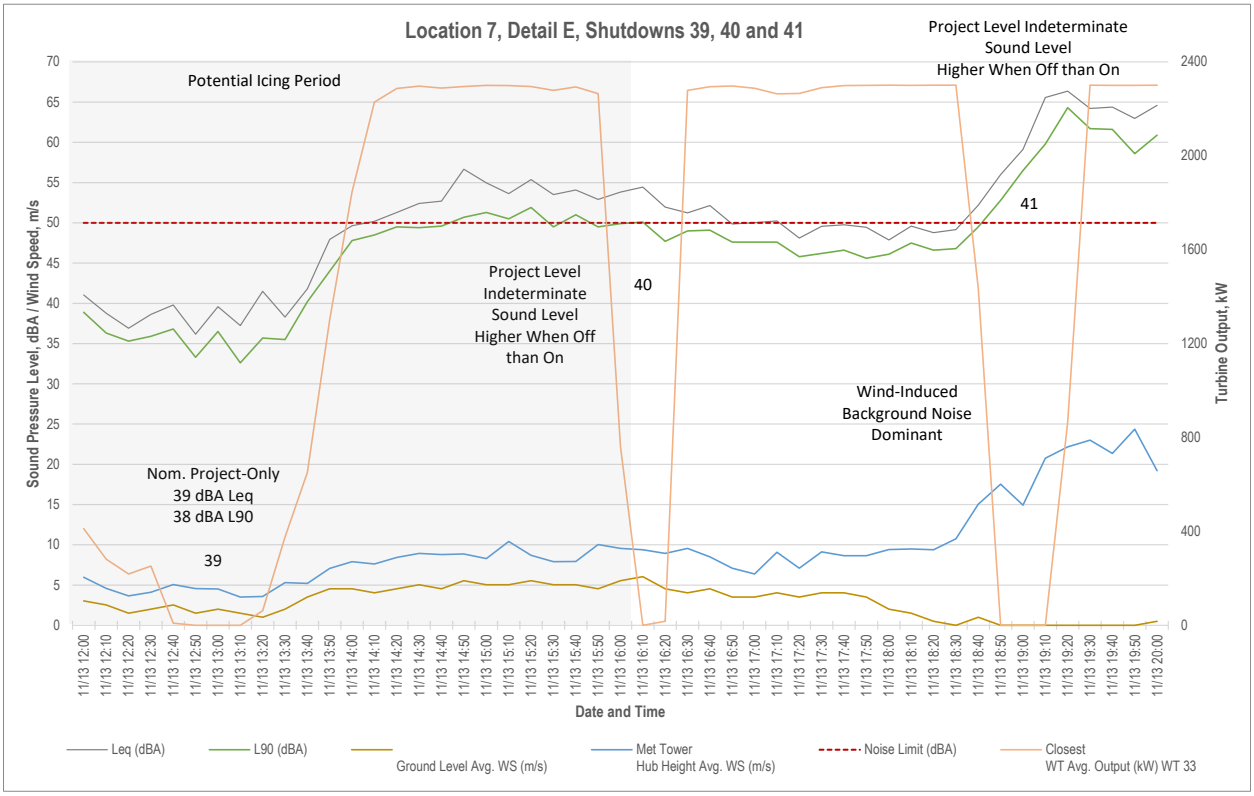

Figure 2.3.6

Finally, the overall sound level during Shutdown 55, shown in Detail F (Figure 2.3.7), did not go down during the outage under ostensibly good conditions (low ground level wind and full power operation). Consequently, the Project-only sound level could not be determined.

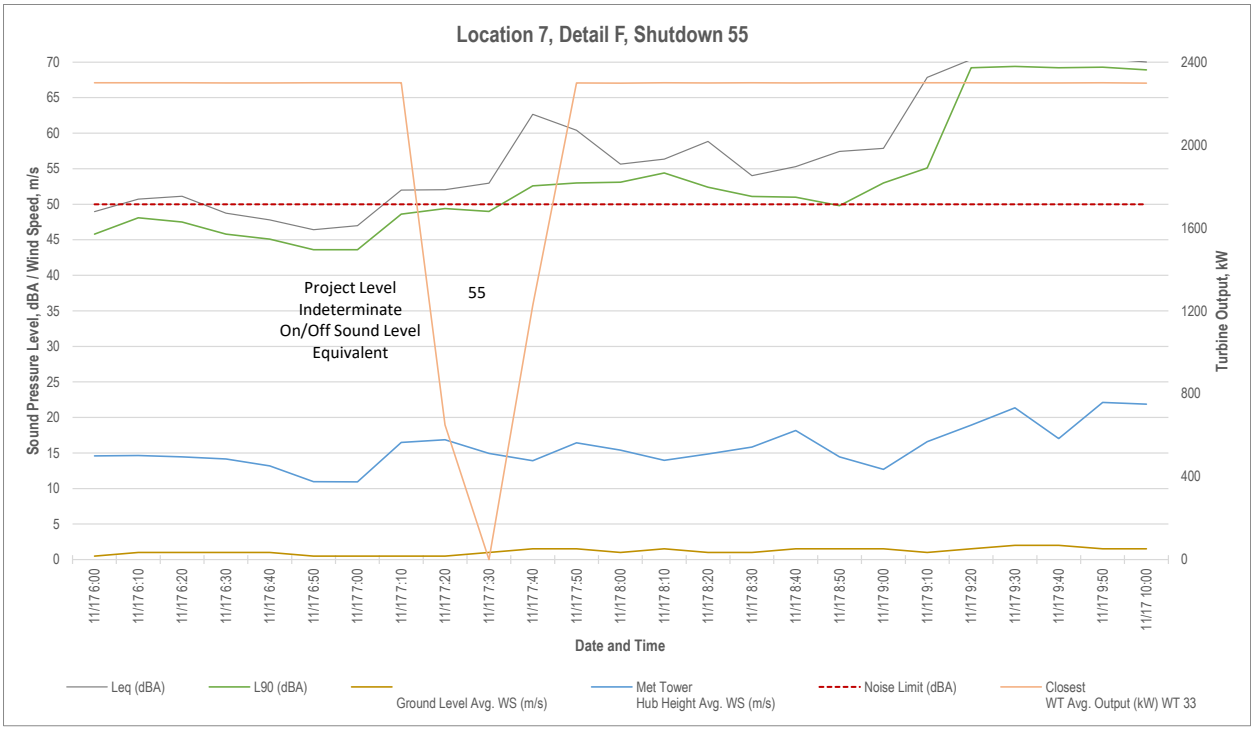

Figure 2.3.7

2.4 Location 8 – Non-Participating Residence, 45 dBA Permit Limit

The overall results for Location 8 are plotted below.

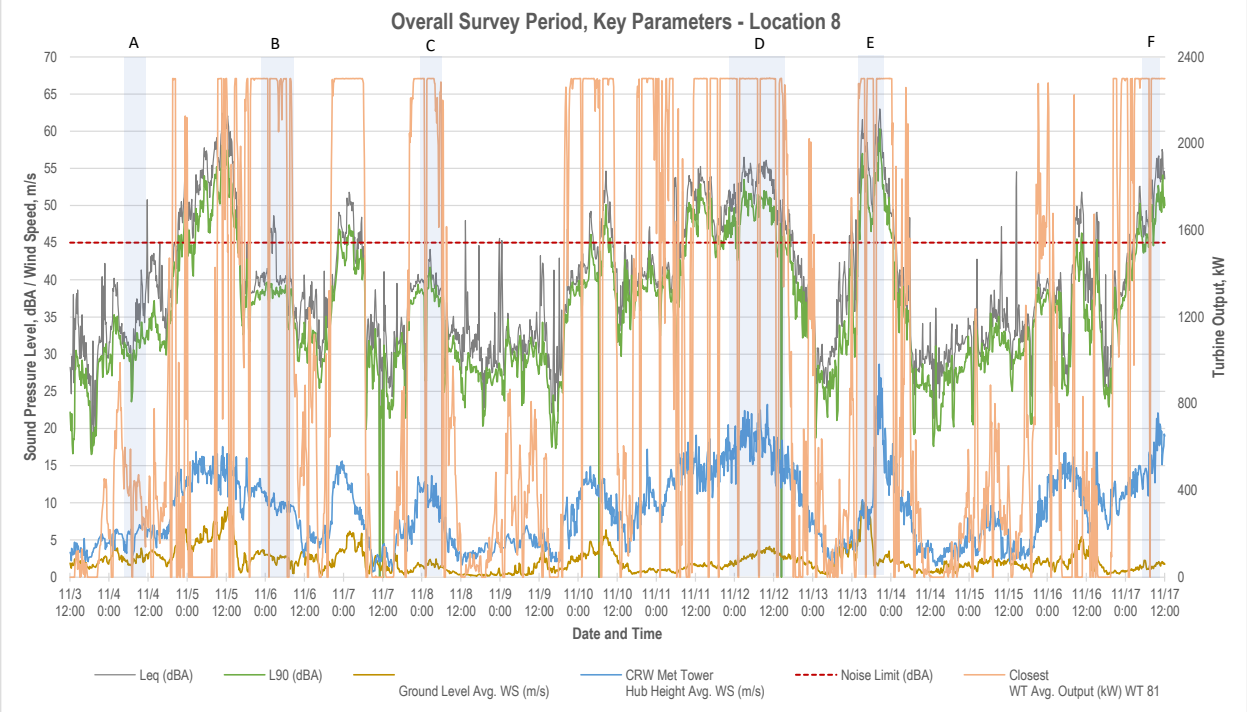

Figure 2.4.1

Detail A (Figure 2.4.2) shows that the Project was detectable during first possible icing period, since the sound level dips a bit during Shutdown 4. The actual differential in the on/off Leq level is only 3 dBA so a valid subtraction to get a definitive Project-only sound level cannot be made, but the nominal result is about 29 dBA. While the sound level rises slightly through the potential icing period it remains well below the 45 dBA limit. During the next shutdown later that day there is no change in the overall sound level when the turbines are shut off; in fact, the sound level is higher during the outage than when it was on before and after.

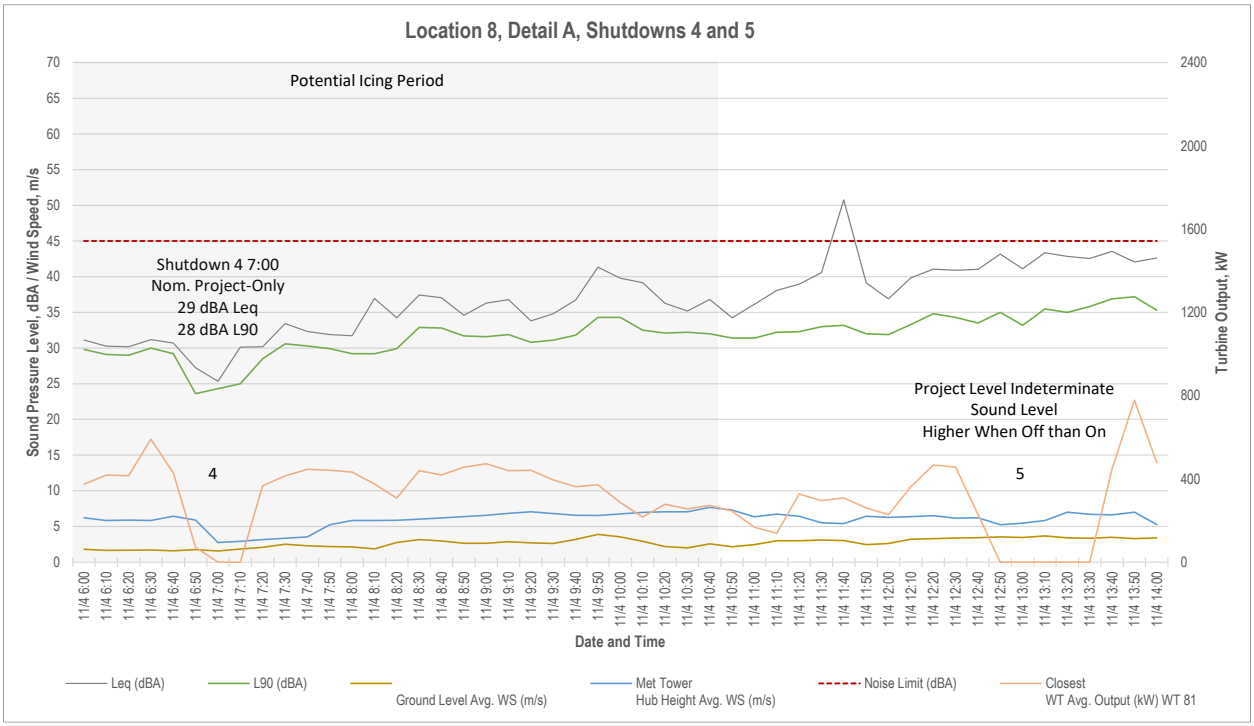

Figure 2.4.2

During the Detail B period (Figure 2.4.3) the operating and wind conditions were favorable enough to quantify the maximum sound emissions of the Project alone at about 38 to 41 dBA.

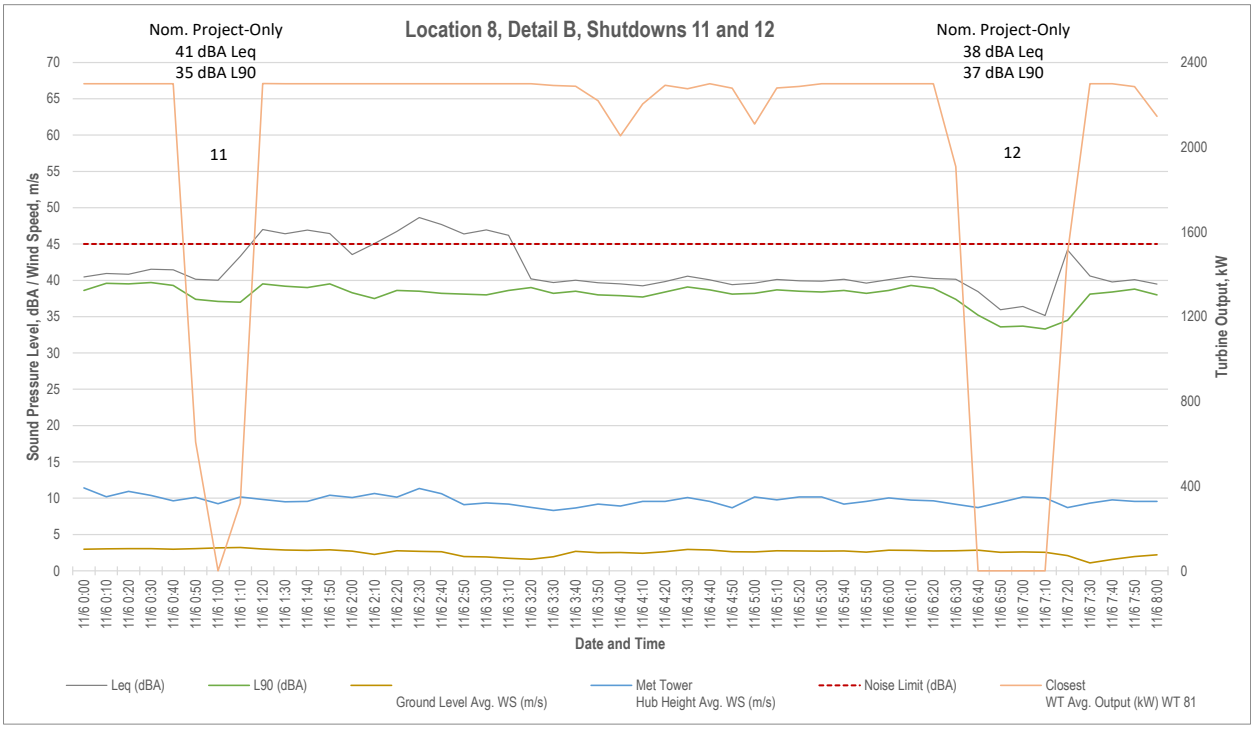

Figure 2.4.3

Similar conditions occurred during the first half of the Detail C period (Figure 2.4.4) allowing the Project sound level at full load to be put at 39 dBA. The Project was again detectable near the end of this period, but the electrical output had dropped to about 50%. For this partial load condition the measurements place the Project sound level at 36 dBA.

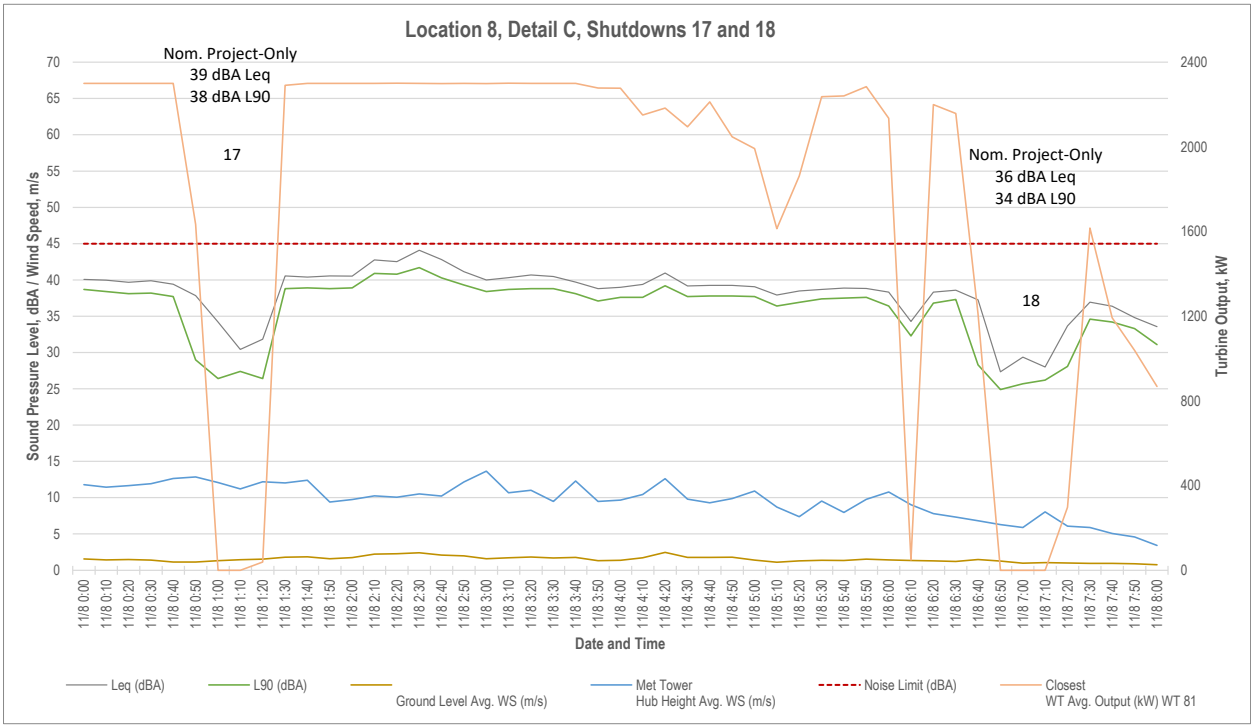

Figure 2.4.4

Detail D (Figure 2.4.5) shows three shutdowns from full power during the potential icing period on November 12. In each case, the removal of the Project's sound emissions had no discernable effect on the total measured sound level. This can be expected since a component sound level in the 39 to 41 dBA range would be low enough to not contribute in any appreciable way to a total sound level in the 50 to 55 dBA range. When one sound is 9 to 10 dB below another it ceases to add anything to the total. Consequently, these three indeterminate results actually support the case that the maximum Project sound level is in the 39 to 41 dBA range at this location.

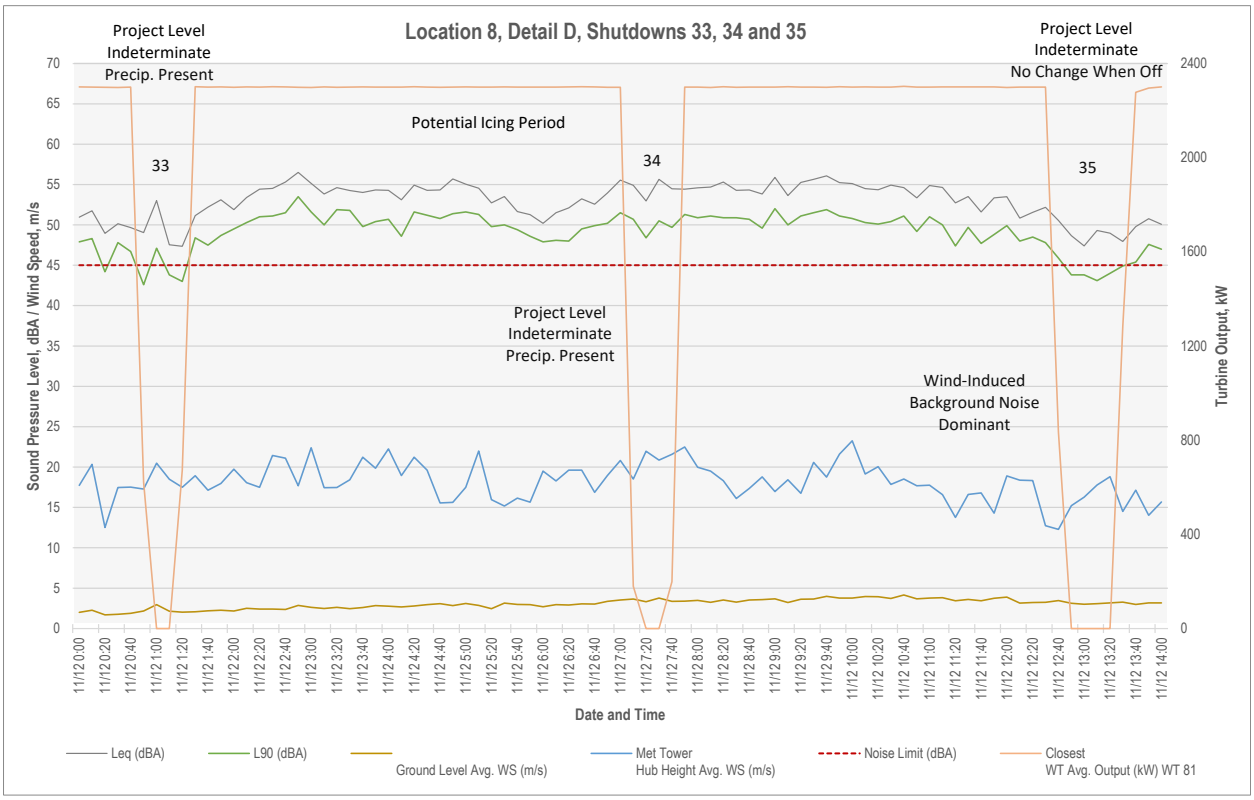

Figure 2.4.5

It was also impossible to determine the Project sound level from the three shutdowns recorded in Detail E (Figure 2.4.6). In the first instance, Shutdown 39, the Project was not only at partial load (rather than full) but some extraneous noise event occurred during the shutdown. Shutdown 40 occurred during a period of high ground level winds masking any Project sound. Again, the Project sound level was probably just undetectable in an environmental sound level of about 59 dBA. As with the first shutdown in this group, some noise event occurred during Shutdown 41 making the average sound level higher with the nearest turbines off than on.

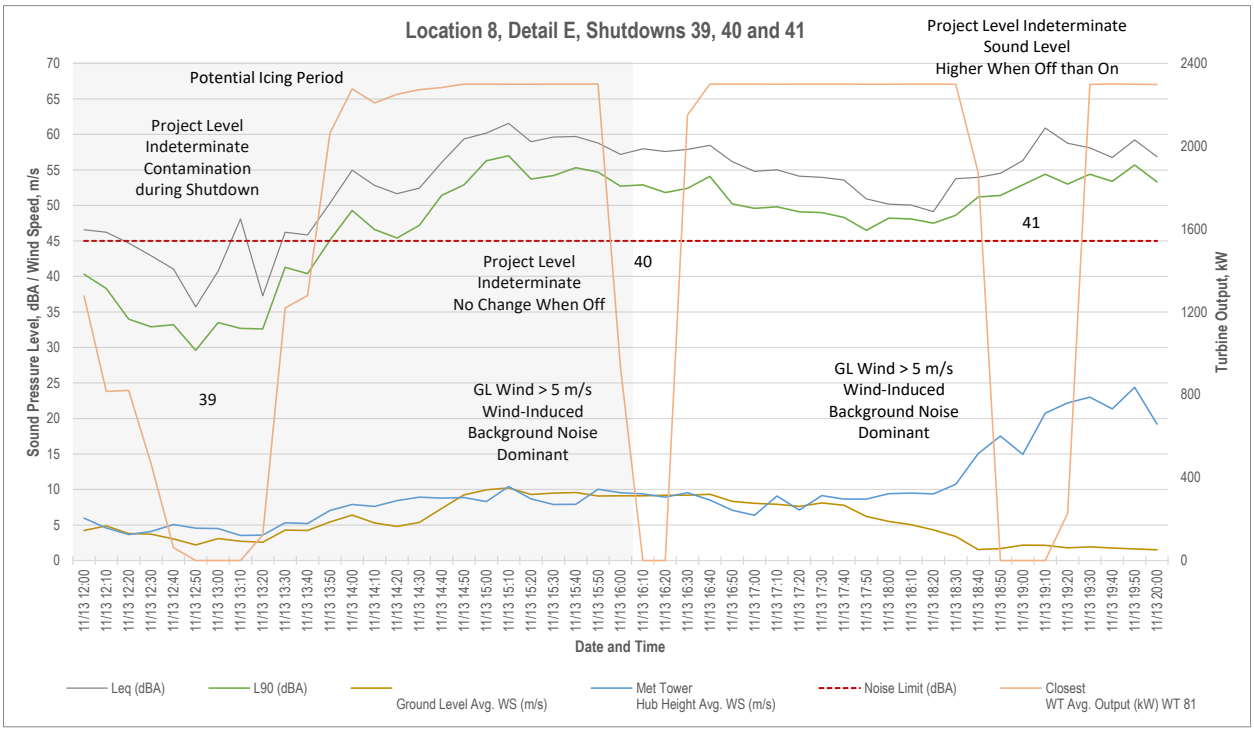

Figure 2.4.6

Detail F (Figure 2.4.7) captures a shutdown during a promising period of low ground level wind and full load operation, but the upper level (hub height) wind was quite high at around 15 m/s and tree rustle noise was apparently dominant. There is no change in the Leq level when the Project was taken offline; in fact, it was again higher during the outage making it impossible to quantify the Project alone.

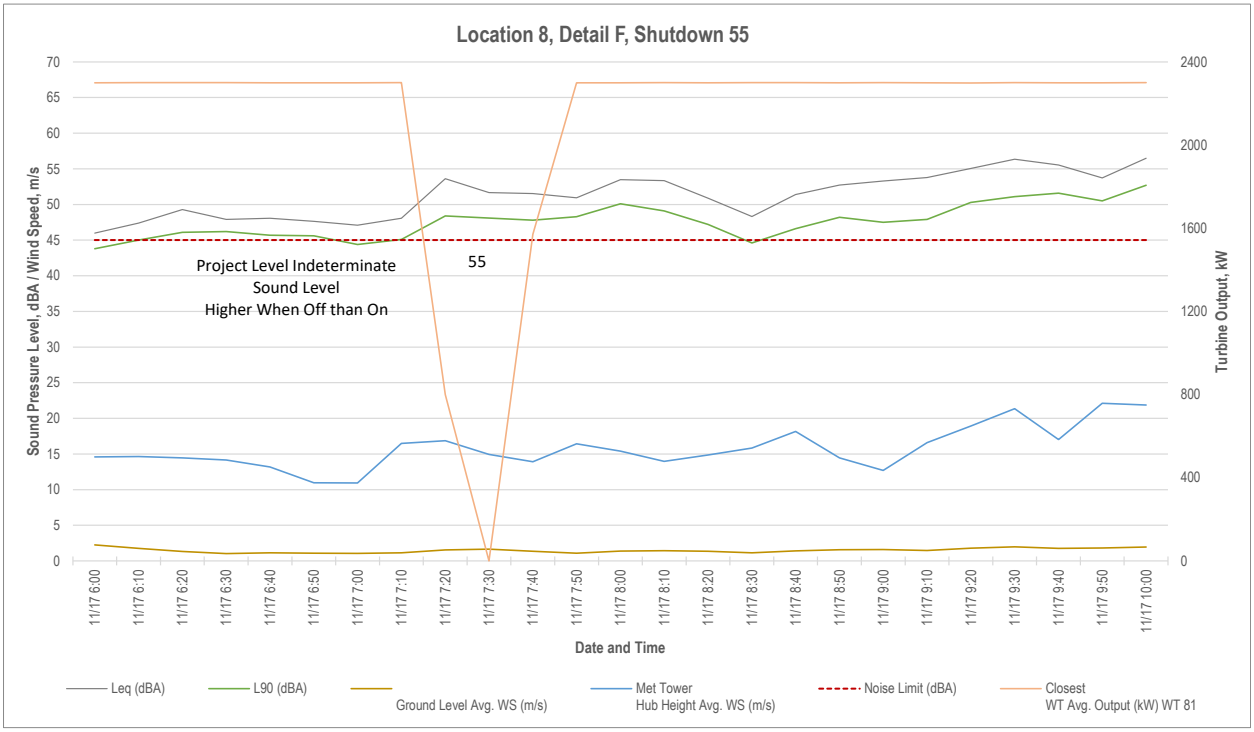

Figure 2.4.7

2.5 Location 9 – Non-Participating Residence, 45 dBA Permit Limit

The overall results for Location 9 are plotted below.

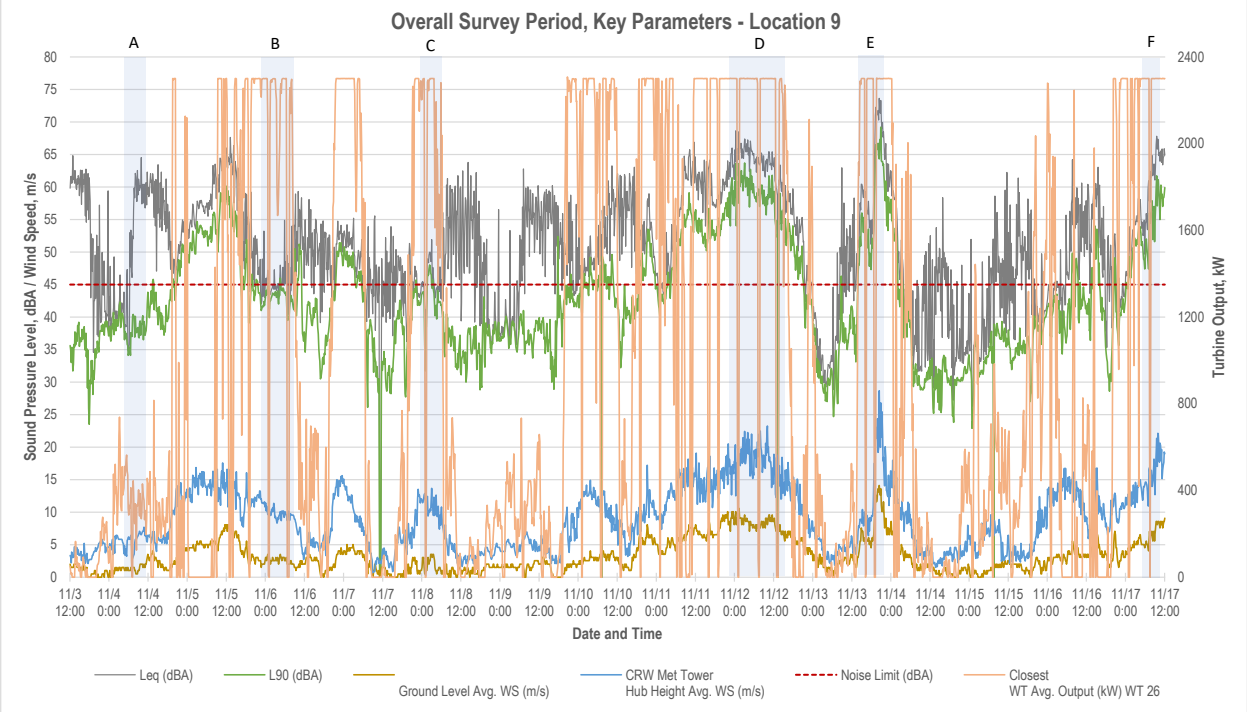

Figure 2.5.1

The two shutdowns during the Detail A period at this position (Figure 2.5.2) show that the high Leq sound levels in the 50 to 60 dBA range were unaffected by, and unrelated to, the Project.

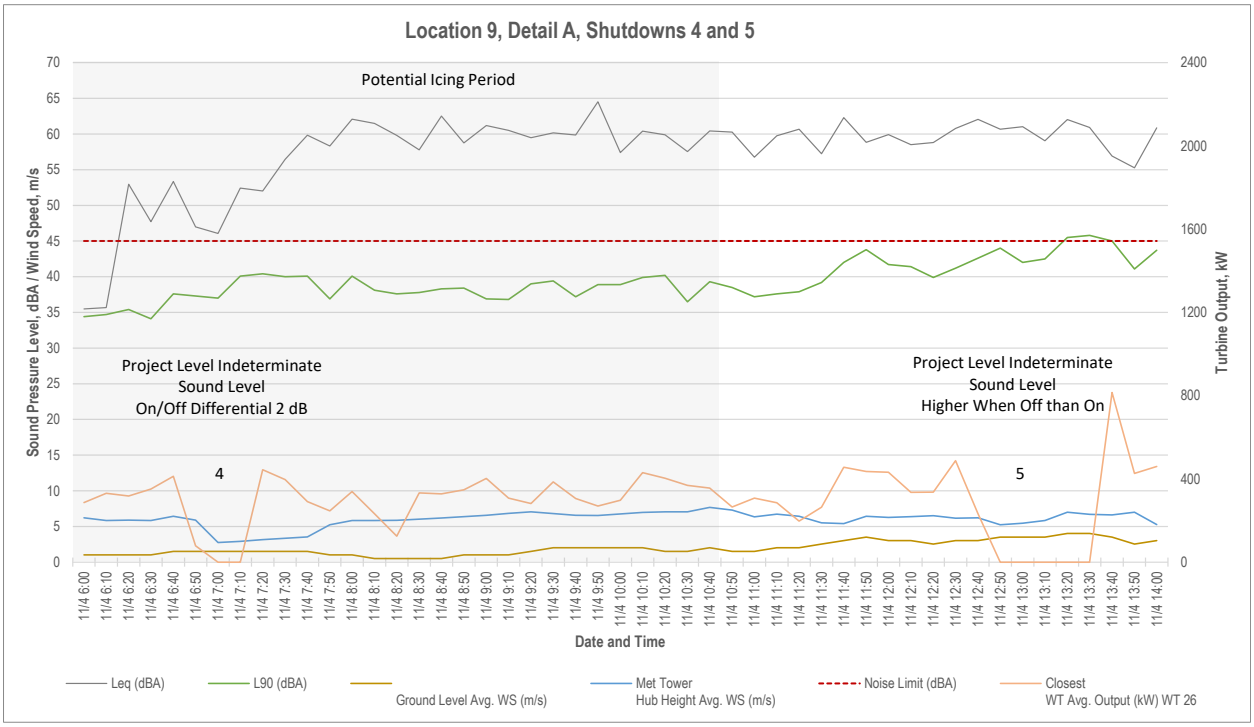

Figure 2.5.2

The ideal conditions that occurred during the Detail B period (Figure 2.5.3) allowed the Project sound level to be quantified at all other positions but at this location there is no appreciable reduction in the sound level during the two outages from full power. The only thing that can be concluded from this data set is that the Project sound level must be lower than then total level, which was nearly constant at 45 dBA through this period. Consequently, although a specific number cannot be put to it, these measurements demonstrate that the Project is compliant at this location.

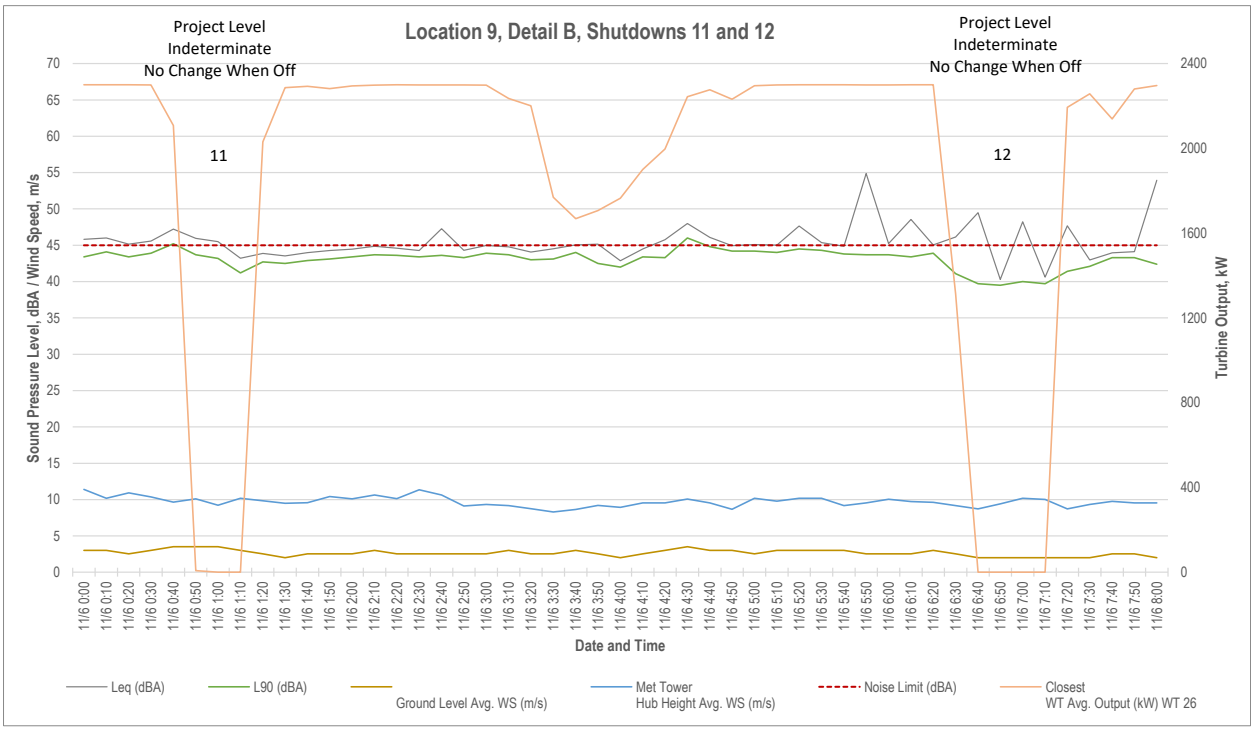

Figure 2.5.3

Under similar conditions two days later the total sound level did go down significantly during outage 17. For at least an hour before this shutdown the total Leq sound level (both Project and background) was steady at 45 dBA (indicating compliance). During the shutdown the sound level dropped to an average of 38 dBA and then increased to around 49 dBA once the turbines were restarted. Mathematically, that ostensibly puts the Project-only sound level 1 dBA over the permit limit of 45 dBA at that Location; however, there is no apparent reason why the Project would be significantly louder after the shutdown than before since the wind and weather conditions were largely unchanged through this outage period. A review of the audio files recorded before, during and after this shutdown indicates only that a hissing, leaf rustle sound is present whether the turbines are on or not. The rhythmic churning sound of wind turbines is not perceptible in the before or after (Project-on) recordings. Consequently, although the numbers suggest that the Project may have been generating a sound level of 46 dBA at this time, it is our view that the data are inconclusive and do not provide enough evidence to demonstrate a permit exceedance – particularly in light of the fact the Project was completely undetectable at this location during all the other shutdowns that were examined, including Shutdown 18 later the same day.

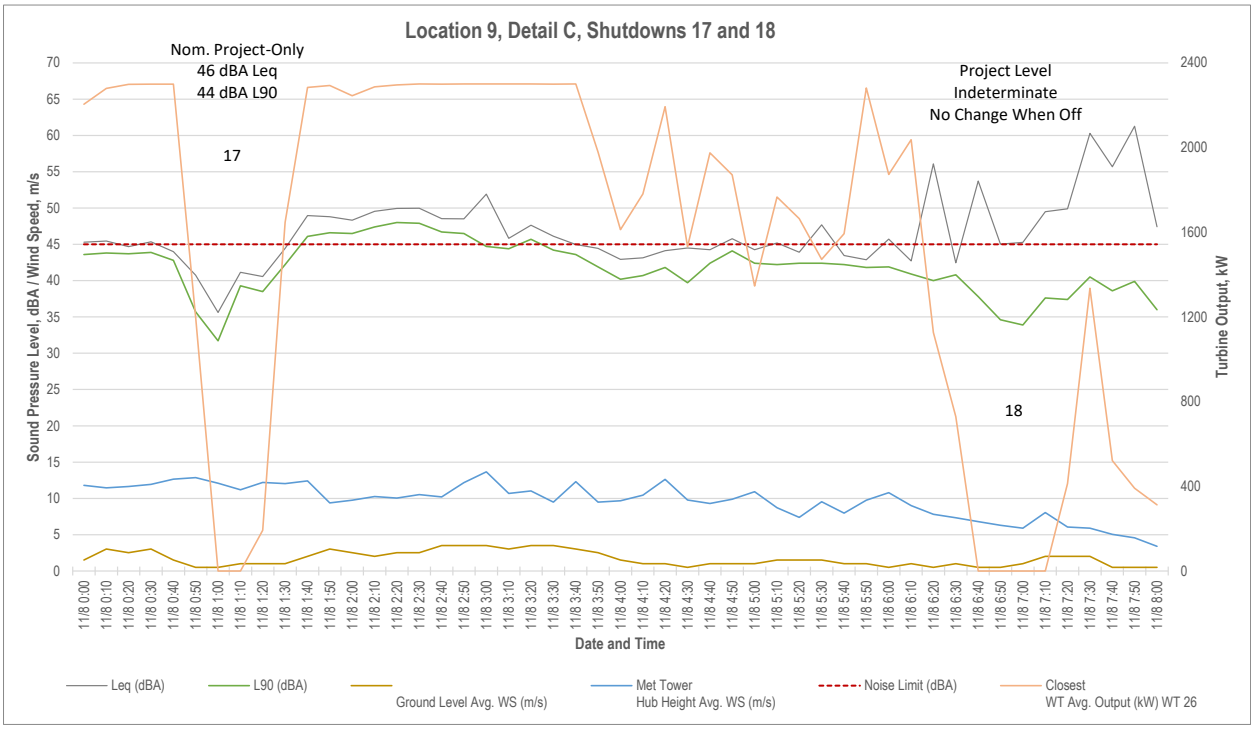

Figure 2.5.4

As at all other test positions, the Project sound level could not be deduced from the three full power shutdowns that occurred during the Detail D period (Figure 2.5.5). Masking noise unrelated to the Project was dominant.

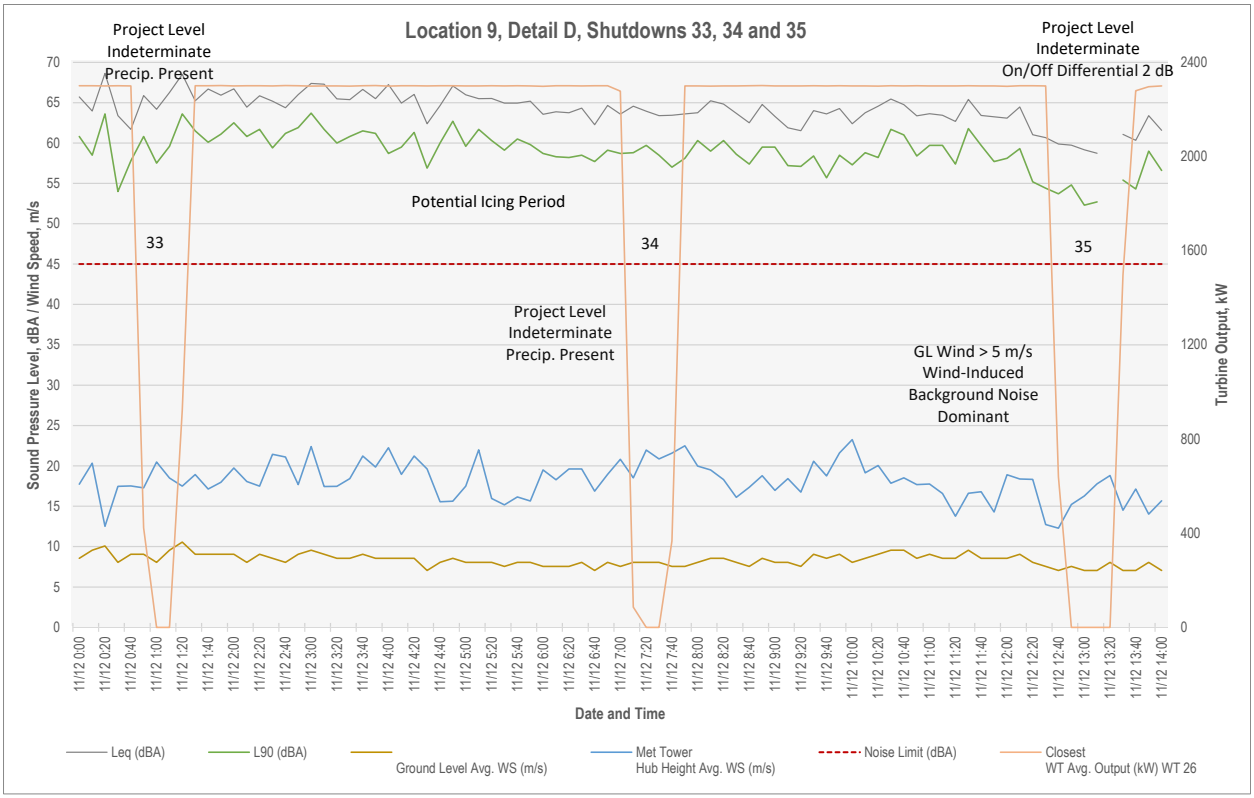

Figure 2.5.5

The Detail E period at this position (Figure 2.5.6) is of interest because the Epsilon test engineer was on hand to make first-hand observations during the period between Shutdowns 39 and 40, when the Leq sound level was above the 45 dBA permit limit. At 14:00 the Project was noted as being audible and the total sound level (background and Project) was around 52 dBA. About an hour and half later, with the total sound level hovering around 59 dBA it was observed that leaf rustle was the dominant sound. The next shutdown (40) just after 16:00 shows that Project noise was not the driving factor causing these high levels, since the sound level remained unchanged through this outage. Although Project noise was present and audible, according to the observations at around 14:00, there is no usable background level available to make a mathematical calculation to determine the Project-only component of the total sound level. However, the lack of any change in sound level during Shutdown 40 suggests that background noise was actually the dominant sound level driver during this period.

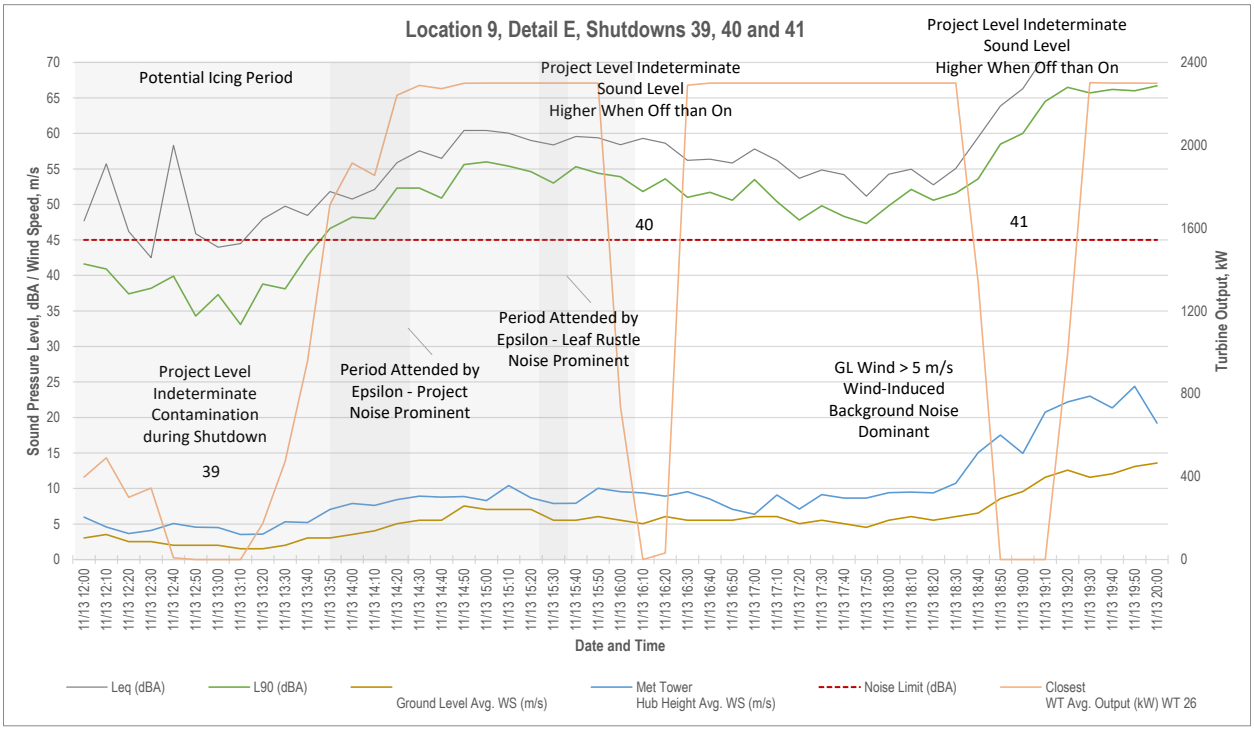

Figure 2.5.6

During the final full power shutdown of the survey, captured in Detail F (Figure 2.5.7), the Project sound level remained undetectable in the presence of wind-induced natural sounds at around 60 dBA during the outage.

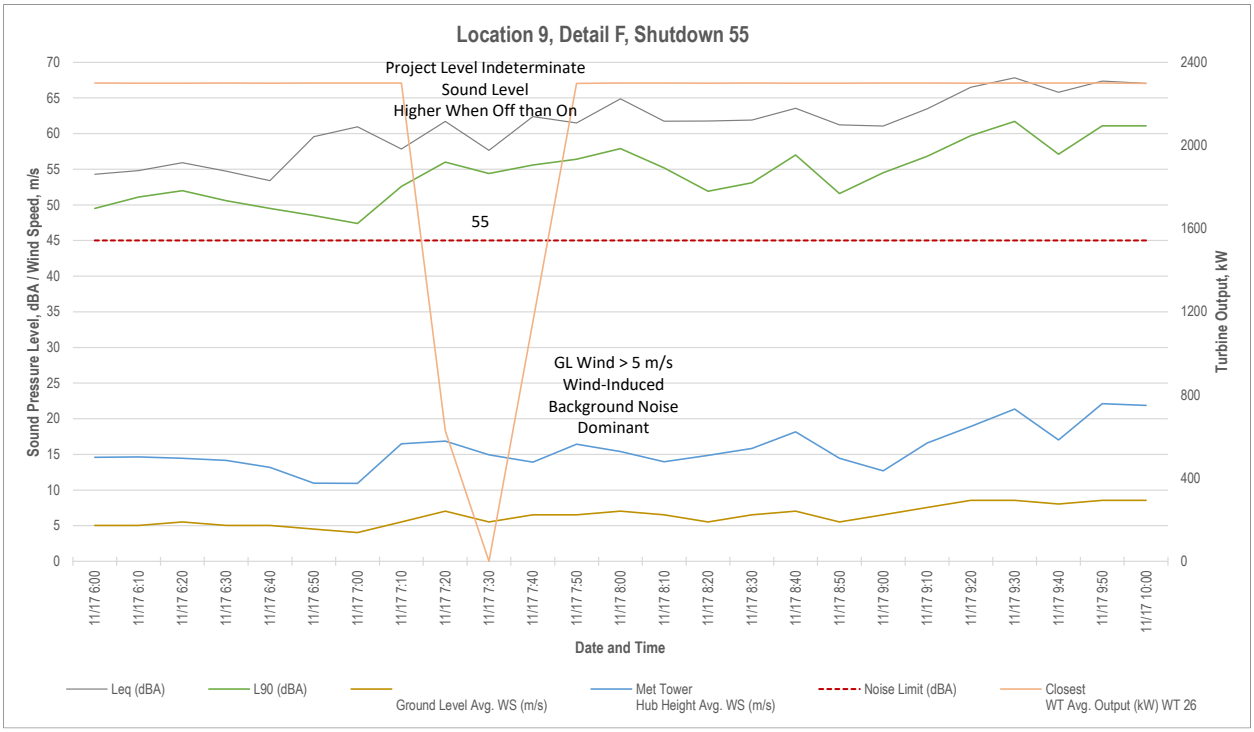

Figure 2.5.7

3.0 Conclusions

A sound level survey of the Crowned Ridge Wind Project was carried out by Epsilon Associates on behalf of the Project in November of 2021 as a part of the mitigation plan addressing potential noise from ice buildup on the turbine blades, which had been observed in a previous survey. The intent of the 2021 survey was to remeasure the Project's sound emissions, after the installation winter ice operating mode (WIOM) software, under conditions where icing could potentially occur. The survey lasted for two weeks and was aided by 58 intentional shutdowns of all turbines within 1.75 miles of the measurement locations to aid in separating the Project sound level from the background sound level that would otherwise exist. A number of periods during which icing could potentially occur were captured during the survey. Epsilon's final report on the survey was submitted to the South Dakota Public Utilities Commission on February 14, 2022 and concluded that the Project was compliant with the noise limit provisions in Condition 26 of the "Final Decision and Order Granting Permit to Construct Facility".

We have reviewed this report and find no deficiencies, omissions or errors and agree with its conclusions.

In addition, we have independently reviewed and analyzed the raw survey data using a graphical approach, rather than the numerical sorting method used by Epsilon, focusing on periods when Project noise was likely to be maximum and/or periods where the weather conditions could have resulted in blade icing. This assessment showed that in all cases where the Project-only sound level could be definitively calculated that those levels were below the permit limit applicable at that location. Since the test positions generally represent the points of maximum exposure to Project sound, compliance at these test points implies compliance at all other residences in the area. In short, we conclude, based on both the Epsilon and our own analysis, that the sound emissions from the Project are in compliance with the permit noise conditions.

Appendix A

CRW LNTE 2021 Sound Level Measurement Program

Wind Turbine Shutdown List

Shutdown	Detail	Date	Start Time	Applicable Locations & Notes
1		Wednesday, November 3, 2021	13:00	All
2		Wednesday, November 3, 2021	19:00	All
3		Thursday, November 4, 2021	1:00	All
4	A	Thursday, November 4, 2021	7:00	All, Potential Icing, Typ.
5	A	Thursday, November 4, 2021	13:00	All
6		Thursday, November 4, 2021	19:00	All
7		Friday, November 5, 2021	1:00	All
8		Friday, November 5, 2021	7:00	All
9		Friday, November 5, 2021	13:00	All
10		Friday, November 5, 2021	19:00	All
11	B	Saturday, November 6, 2021	1:00	All
12	B	Saturday, November 6, 2021	7:00	All
13		Saturday, November 6, 2021	13:00	All
14		Saturday, November 6, 2021	19:00	All
15		Sunday, November 7, 2021	7:00	All
16		Sunday, November 7, 2021	19:00	All
17	C	Monday, November 8, 2021	1:00	All
18	C	Monday, November 8, 2021	7:00	All
19		Monday, November 8, 2021	13:00	All
20		Monday, November 8, 2021	19:00	All
21		Tuesday, November 9, 2021	1:00	All
22		Tuesday, November 9, 2021	7:00	All
23		Tuesday, November 9, 2021	13:00	All
24		Tuesday, November 9, 2021	19:00	All
25		Wednesday, November 10, 2021	1:00	All
26		Wednesday, November 10, 2021	7:00	All
27		Wednesday, November 10, 2021	13:00	Precipitation Recorded
28		Wednesday, November 10, 2021	19:00	Precipitation Recorded
29		Thursday, November 11, 2021	1:00	All
30		Thursday, November 11, 2021	7:00	All
31		Thursday, November 11, 2021	16:00	Precipitation Recorded, Potential Icing
32		Thursday, November 11, 2021	19:00	Precipitation Recorded, Potential Icing
33	D	Friday, November 12, 2021	1:00	Precipitation Recorded
34	D	Friday, November 12, 2021	7:20	Precipitation Recorded
35	D	Friday, November 12, 2021	13:00	All
36		Friday, November 12, 2021	19:00	Precipitation Recorded
37		Saturday, November 13, 2021	1:00	All
38		Saturday, November 13, 2021	7:30	All EXCEPT Location 6 (CRWII operating)
39	E	Saturday, November 13, 2021	13:00	Precipitation Recorded, Potential Icing
40	E	Saturday, November 13, 2021	16:10	All
41	E	Saturday, November 13, 2021	19:00	All
42		Sunday, November 14, 2021	1:00	All
43		Sunday, November 14, 2021	7:00	All
44		Sunday, November 14, 2021	13:00	All
45		Sunday, November 14, 2021	19:00	All

Appendix A

CRW LNTE 2021 Sound Level Measurement Program

Wind Turbine Shutdown List

Shutdown	Detail	Date	Start Time	Applicable Locations & Notes
46		Monday, November 15, 2021	1:00	All
47		Monday, November 15, 2021	7:10	All EXCEPT Location 6 (CRWII operating)
48		Monday, November 15, 2021	13:00	Precipitation Recorded, Potential Icing
49		Monday, November 15, 2021	19:00	All
50		Tuesday, November 16, 2021	1:00	All
51		Tuesday, November 16, 2021	7:00	All
52		Tuesday, November 16, 2021	13:00	All
53		Tuesday, November 16, 2021	19:00	All
54		Wednesday, November 17, 2021	1:00	All
55	F	Wednesday, November 17, 2021	7:30	All EXCEPT Location 6 (CRWII operating)
56	F	Wednesday, November 17, 2021	19:00	Location 6 only
57	F	Thursday, November 18, 2021	1:00	Location 6 only
58	F	Thursday, November 18, 2021	7:00	Location 6 only, Potential Icing